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An Activity of the Naval Material Command

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CONTENTS

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PREFACE

This booklet has been prepared by the Technical Information Department to make readily available the titles and abstracts of unrestricted publications by employees of the Naval Weapons Center issued during 1969. It lists official publications released to the Clearinghouse for Federal, Scientific, and Technical Information for dissemination under Public Law 776, professional papers published in the open literature, and U.S. Patents. It is hoped that this booklet will contribute to the cross-fertilization of ideas and the elimination of unnecessary duplication of effort.

The official publications are listed by series number (NWC TP); the professional papers alphabetically by first author; and the patents by U.S. Patent Number. An author index appears at the end.

Part 3 of the *Naval Weapons Center Technical History 1969* (NWC TP 4832, Part 3) records all the technical publications of this Center issued during the year. In addition to the listing herein, it includes official publications of limited distribution, technical motion pictures, and Navy patent cases under secrecy order. These are available to persons with established need-to-know through the channels for classified information.

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1 April 1970

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OFFICIAL PUBLICATIONS

NWC Technical Publication 4672

Selected Video and Pulse Circuitry, by Richard S. Hughes. China Lake, Calif., NWC, January 1969. 144 pp. Publication UNCLASSIFIED.

This report presents several relatively important video and pulse circuits designed at NWC during the past 5 years (1963 through 1968). These circuits include video amplifiers (the differential amplifier is discussed in detail), variable gain amplifiers, logarithmic amplifiers, switching circuits (one-shots, Schmitt triggers) and all have been useful in the design of radar receivers.

Basic analysis of each circuit is presented as well as examples.

PROFESSIONAL PAPERS

OL 1302

Ansell, Gerald B. "Crystal Structure of 3,6-Bisdiazocyclohexanetetraone, $C_6N_4O_4$," CHEM SOC (London), J, No. 1909, Sec. B, Physical Organic Chemistry (June 1969), pp. 729-32.

Crystals of 3,6-bisdiazocyclohexanetetraone ($C_6N_4O_4$) are monoclinic, space group $P2_1/a$ and there are 2 molecules in the unit cell of dimensions $a = 8.439$, $b = 7.093$, $c = 6.553$ Å, $\beta = 111.7^\circ$. The intensity data were measured using an automatic diffractometer and copper radiation. The structure was refined by full-matrix least-squares methods to R 0.079 for 418 observed reflections. The compound is best described as a bisdiazonium enolate. The molecule is planar with an N-N value of 1.107 (σ0.010) Å (clearly a triple bond) and a C-N value of 1.357 (σ0.010) Å. The C-N-N angle is 179.9°. There are two C-C distances of 1.437 and 1.433 (σ0.010) Å and one of 1.541 (σ0.010) Å. There are two independent C-O values of 1.208 and 1.214 Å.

OL 1303

Ansell, Gerald B., and William G. Finnegan. "The Crystal Structure of a Complex Between Silver Iodide and Morpholine (AgI,C_4H_9NO)," CHEM COMMUN D17, September 1969, pp. 960-61.

An X-ray analysis of the structure of the complex between silver iodide and morpholine has been carried out.

OL 1304

Ansell, Gerald B., and William G. Finnegan. "The Crystal Structure of a Complex Between Silver Iodide and Piperazine ($AgI.1/2\ C_4N_2H_{10}$)," CHEM COMMUN, November 1969, p. 1300.

The X-ray crystallographic structure determination of the complex between silver iodide and piperazine ($AgI\cdot 1/2\ C_4N_2H_{10}$) is reported.

OL 1305

Ansell, Gerald B., Lohr A. Burkardt, and William G. Finnegan. "The Structure of Complex Between Silver Iodide and Piperidine ($AGI,C_5H_{11}N$)," CHEM COMMUN, April 1969, pp. 459-60.

An X-ray analysis of the structure of the complex between silver iodide and piperidine has been carried out.

OL 1306

Ansell, G. B., P. R. Hammond, Susanne V. Hering, and P. Corradini. "Studies on Complexes-XIV. Acceptor Properties and Structure of 1,4-Bisdiazocyclohexanetetraone, $C_6N_4O_4$," Tetrahedron, Vol. 25, No. 12 (June 1969), pp. 2549-54.

The acceptor properties of 1,4-bisdiazocyclohexanetetraone have been examined and the structure established by X-ray crystallography.

OL 1307

Bauer, E. "Inelastic Scattering of Slow Electrons in Solids," Z PHYSIK, Vol. 224, No. 1-3 (June 1969), pp. 19-44.

A theory of the inelastic scattering of slow electrons in solids due to excitation of interband transitions is developed. It is shown that both nondirect and direct transitions occur which can be described by a generalization of the formation used in solid state optics. Experiments with 30-200 eV electrons scattered from Si(111) surfaces with well defined surface structures as determined by low energy electron diffraction confirm the theoretical predictions. They indicate that the inelastic scattering of slow electrons can be understood in terms of the three-dimensional band structure of solids and suggest the use of inelastic low energy electron scattering as a tool for band structure analysis.

OL 1308

Bauer, E. Techniques in Metals Research. New York, Interscience Publishers, 1969. Vol. II, Chap. 16, "Low Energy Electron Diffraction (LEED)," pp. 559-639.

OL 1309

Bauer, E. "On the Interpretation of Complex LEED Patterns," in The Structure and Chemistry of Solid Surfaces, ed. by G. A. Somorjai. New York, John Wiley & Sons, Inc., 1969. Pp. 23-1/23-25.

OL 1310

Bauer, E. Techniques in Metals Research. New York, Interscience Publishers, 1969. Vol. II, Chap. 15, "Reflection Electron Diffraction (RED)," pp. 501-58.

OL 1311

Beckstead, M. W. "Low Frequency Instability: a Comparison of Theory and Experiment," COMBUST AND FLAME, Vol. 12, No. 1 (October 1968), pp. 417-26.

The literature contains many theoretical analyses describing combustion instability of solid propellants. The majority of these have been applied to acoustic instability and are therefore framed in a format compatible with the acoustics of a rocket chamber. However, in the low frequency regime these models should apply to non-acoustic instability as well as acoustic instability. In the present paper the results of two such models are compared and the response functions (which are the end result of the analyses) were found to be essentially the same function of frequency in both models. These results are then compared with non-acoustic data obtained with an L* burner. The data from the L* burner have been reduced to the format used in the models and then compared with the theoretical response function. In addition, non-acoustic instability appears to be critically dependent on the combustion and chamber time constants. In the models this relationship appears as the combustion phase lead relative to pressure. Therefore, the data have been compared with the predicted phase relationship as well as with the real part of the response function. From this curve-fitting type of comparison, a value for the parameters in the models can be determined. With the parameters evaluated, the response functions of the combustion models can then be substituted directly into the results of the non-acoustic analysis to give predictions for non-acoustic instability behavior. A comparison of the trends of theoretical calculations is qualitatively in agreement with the actual data. However, slight discrepancies are present.

OL 1312

Beckstead, M. W., H. B. Mathes, E. W. Price, and F. E. C. Culick. "Combustion Instability of Solid Propellants," in Twelfth Symposium (International) on Combustion. Pittsburgh, Pa., Combustion Institute, 1969. Pp. 203-11.

Experimental data has been obtained from two T-burners and an L* burner over a range of frequencies from 10 cps to 8000 cps and from 25 psia to 1000 psia. From these data the response of the propellants to a pressure perturbation has been calculated and has been found to be consistent between burners. The results have been interpreted as a response function surface with burning rate and frequencies as independent variables. The data indicates that for a given pressure level the response function has a peak value at a frequency that increases as pressure increases. The magnitude of this peak height varies with pressure so that there is a localized peak in the response function surface for a given propellant. The results are in qualitative agreement with theoretical studies in that the models also predict a maximum value in the response function. However, they also predict that this magnitude should be approximately a constant and not dependent on the pressure and frequency to the extent observed in the present study. The results obtained for an aluminized propellant indicate that presence of metal in the combustion zone greatly influences both the magnitude of the response function peak as well as its location.

OL 1313

Bennett, H. E., D. K. Burge, R. L. Peck, and J. M. Bennett. "Validity of Ellipsometry for Determining the Average Thickness of Thin, Discontinuous, Absorbing Films," OPT SOC AMER, J, Vol. 59, No. 6 (June 1969), pp. 675-81.

We have tested the validity of the ellipsometric equations for correctly predicting the average thickness of thin, discontinuous, absorbing, inorganic films, by studying the growth of silver sulfide tarnish films on silver. The ellipsometrically determined thicknesses of the tarnish films were in a constant ratio to, and nearly the same as, thicknesses determined by direct measurement with the electron microscope. They actually fell between the values determined by two different electron-microscope methods, one of which should give numbers which are too large and the other numbers which may be too small. We can thus conclude that, at least for thicknesses less than 80 Å, the ellipsometric method, using thick-film indices, gives very nearly correct average values for these discontinuous films.

OL 1314

Bennett, H. E., R. [illegible]. Peck, D. K. Burge, and J. M. Bennett. "Formation and Growth of Tarnish on Evaporated Silver Films," J APPL PHYS, Vol. 40, No. 8 (July 1969), pp. 3351-60.

We have studied the growth of the silver sulfide tarnish film which forms on silver deposited on smooth, amorphous substrates and rough and smooth polycrystalline substrates. Both ellipsometric and electron microscope techniques were used to measure the average thickness of the tarnish films. The growth rate was found to be variable depending on the concentration of the sulfurous gases. In normal laboratory air (measured concentrations of H_2S and SO_2 less than 0.2 parts per billion) a 1-Å-thick tarnish film can be expected to form in 1 h, 3-6 Å in 1 day, 15-30 Å in 1 week, and 60 Å or more in 1 month. The tarnish growth can be completely stopped by placing the silver in a dry-nitrogen atmosphere. Conversely, in a humid atmosphere containing about 10% H_2S, growth rates of as much as 100 Å/H can be obtained. The silver sulfide formed as small, randomly spaced, approximately round clumps having a site density about one hundred times larger than the patch density reported for thermally etched silver surfaces. All clumps nucleated on initial exposure, the clump density remained constant with time, and the clumps grew much slower than the tarnish patches on thermally etched silver. Coalescence toward a continuous film was slow; even after 41 days, only 53% of one silver surface was covered with tarnish.

OL 1315

Bennett, Jean M., and Maxine J. Booty. "Computer Program for Determining Optical Constants of a Film on an Opaque Substrate," Letter to the Editor, APPL OPT, Vol. 8, No. 11 (November 1969), pp. 2366-68.

A computer program is described which can be used to obtain the optical constants of a thin, transparent or absorbing film on a highly reflecting substrate of known optical constants. Input data are the measured reflectance of the uncoated substrate, the reflectance of the substrate-film combination for two films of different thickness, and the thicknesses of the films.

OL 1316

Boggs, T. L. "Ammonium Perchlorate Deflagration: The Relevance of Decomposition Kinetics," in 7th Meeting Bulletin, Interagency Chemical Rocket Propulsion Group, comp. and ed. by Chemical Propulsion Agency. Silver Spring, Md., CPIA, August 1969. CPIA Pub. No. 189, Vol. 1, pp. 59-77.

OL 1317

Boggs, T. L. "The Deflagration of Pure Single Crystals of Ammonium Perchlorate," New York, American Institute of Aeronautics and Astronautics, 1969. AIAA paper No. 69-142. 9 pp.

This paper describes the self-deflagration of single crystals of pure ammonium perchlorate (AP). This deflagration behavior has been divided into four phenomenological regimes. These regimes are apparent when the data presented in this paper are examined. These data include (1) the deflagration rate as a function of pressure for the AP crystals, (2) the combustion characteristics as seen using cinemicrophotography and (3) the surface and subsurface characteristics of quenched samples as observed using the scanning electron microscope. From these data the energy transfer mechanism for each regime has been inferred.

OL 1318

Boggs, T. L., and K. J. Kraeutle. "Role of the Scanning Electron Microscope in the Study of Solid Rocket Propellant Combustion. I. Ammonium Perchlorate Decomposition and Deflagration," COMBUST SCI TECHNOL, Vol. 1, No. 2 (September 1969), pp. 75-93.

OL 1319

Boggs, T. L., O. H. Madden, and M. W. Beckstead. "The Effect of Oxidizer Particle Size and Binder Type on Nonacoustic Instability," New York, American Institute of Aeronautics and Astronautics, 1969. AIAA paper No. 69-175. 7 pp.

Experimental data concerning nonacoustic combustion instability of solid propellants are presented and compared with the predictions of theoretical models. This comparison reveals that the models are inadequate to predict the behavior of certain propellants, such as in the case of polyurethane binder systems, where at least two basic assumptions used in formulating the models are seriously violated. Contrary to these assumptions, the heterogeneity of the propellant and the relationship of the thermal wave thickness to the oxidizer particle sizes are factors that cannot be neglected.

OL 1320

Boggs, T. L., J. L. Prentice, K. J. Kraeutle, and J. E. Crump. "The Role of the Scanning Electron Microscope in the Study of Solid Propellant Combustion," in Proceedings of the Second Annual Scanning Electron Microscope Symposium, sponsored by IIT Research Institute, Chicago, 1 May-29 April 1969, pp. 349-64.

The role of the scanning electron microscope (SEM) in solid propellant research is described. Structures of propellant ingredients which had experienced such processes as heating, decomposition, phase transition, oxidation, combustion, and thermal quenching were examined with the SEM. This examination has also allowed the interpretation of results obtained using other experimental methods. The data provided by the SEM have been used to infer the physical and thermochemical mechanisms of the following processes: ammonium perchlorate decomposition and deflagration, metal particle combustion and agglomeration, and the interaction of the oxidizer and binder during combustion. In many cases, SEM analysis has permitted a choice between existing hypotheses describing various aspects of the combustion.

OL 1321

Burge, D. K., J. M. Bennett, R. L. Peck, and H. E. Bennett. "Growth of Surface Films on Silver," SURFACE SCI, Vol. 16 (August 1969), pp. 303-20.

Ellipsometry was used to determine growth rates for the Ag_2S corrosion film which forms on silver in room air. This system is a particularly unfavorable one for an ellipsometric investigation since the Ag_2S is strongly absorbing and grows as a discontinuous film. The calculational problem of determining the thickness of a very thin absorbing film was solved by using the refractive index we obtained from artificially grown, thick Ag_2S and showing that probable variations in this index will not greatly affect the calculated thickness values. When freshly evaporated silver films were held in vacuum no appreciable growth could be detected until the air admitted to the vacuum system reached a pressure of about 70 Torr. An absorbed layer, probably water vapor, was observed beginning at a pressure of about 6 Torr. At atmospheric pressure the Ag_2S grew initially at a rate of roughly 0.6 Å per hour but the rate decreased with time and was found to be quite sensitive to atmospheric conditions in the laboratory. In a week films were typically about 25 Å thick. Samples of Ag_2S on silver were also examined using transmission electron microscopy, and the film thicknesses determined from the micrographs correlated well with those measured ellipsometrically. These results demonstrate that ellipsometry does give reliable average film thicknesses even for films which are discontinuous and strongly absorbing.

OL 1322

Causey, Nell B, and Darwin L. Tiemann. "A Revision of the Bioluminescent Millipedes of the Genus *Motyxia* (Xystodesmidae, Polydesmida)," AMER PHIL SOC, PROC, Vol. 113, No. 1 (February 1969).

OL 1323

Conger, Robert L. "Model for Converging Detonations in Solid Explosives," MATH PHYS, Vol. 9, No. 7 (July 1968) pp. 1036-40.

The fluid-dynamic equations which describe converging detonation fronts in high explosives are solved over a coordinate system that changes from circular to a pleated pattern as the detonation converges. There are three reasons for introducing such a coordinate system rather than making the usual assumption that when a spherical or cylindrical explosive charge is initiated simultaneously on its curved surface the detonation front maintains its symmetry as the detonation converges to the center: (1) Calculations made elsewhere show that a converging circular shock wave is unstable. (2) Calculations in this paper show that if spherical or cylindrical symmetry is maintained, density and velocity become infinite, but if the detonation front folds these quantities remain finite except at a few points which can be removed by cuts. The average fluid velocity remains almost constant over 99% of the detonation front. (3) Experiments indicate that a cylindrical detonation front becomes rather symmetrically deformed.

OL 1324

Cordes, Herman F. "An Estimate of the Melting Point of Ammonium Perchlorate," AMER INST AERONAUT ASTRONAUT J, Vol. 7, No. 6 (June 1969), pp. 1193-95.

The melting point of NH_4ClO_4 is estimated, using the theory of corresponding states to be 865° ± 20°K.

OL 1325

Culick, F. E. C. "An Elementary Calculation of the Combustion of Solid Propellants," ASTRONAUT ACTA, Vol. 14, No. 2 (1969), pp. 171-81.

The problem of the burning of a solid propellant is treated in an approximate manner by prescribing the spatial distribution of energy release in the gas phase. Adoption of this inverse approach converts the usual non-linear problem to a linear eignvalue problem which is easily solvable. Results for concentrated combustion (a flame front) and special cases of distributed energy release are given. Qualitative aspects such as flame stand-off distance, flame thickness, and various components of heat transfer within the combustion region are clearly shown. Examination of the influence of energy loss by radiation from the solid-gas interface gives satisfactory agreement with previous computations based on the non-linear formulation. An application to the problem of unsteady burning, and the response to pressure fluctuations is discussed briefly. The ease with which useful results can be obtained seems to justify the imperfect nature of the analysis.

OL 1326

Culick, F. E. C., and George L. Dehority. "Analysis of Acoustic Waves in a Cold-Flow Rocket," J SPACECRAFT, Vol. 6, No. 5 (May 1969), pp. 591-95.

A promising method for determining the losses in a rocket chamber during combustion instability is based on acoustic measurements at room temperature. This method permits the losses to be determined from experiments in a small-scale model of the actual chamber. The calculations presented here treat the acoustics of a chamber with mean flow; they are intended to be used in the design of such experiments and in the interpretation of data.

OL 1327

Donovan, T. M., W. E. Spicer, and J. M. Bennett. "Evidence for a Sharp Absorption Edge in Amorphous Ge," PHYS REV LETT, Vol. 22, No. 20 (May 1969), pp. 1058-61.

A sharp optical absorption edge has been found at about 0.5 eV for amorphous Ge on a quartz substrate. The edge is comparable in sharpness with the direct edge of crystalline Ge. No evidence for tailing of the band edges in the forbidden band or for a high density of states in the forbidden band is found by these optical measurements. A new density determination gives a value of 4.54 ± 0.14 g/cm^3.

OL 1328

Fine, D. A. "On the Spontaneous Reduction of Hexachloroiridate(IV) in Aqueous Solution," J INORG CHEM, Vol. 8, No. 4 (April 1969), pp. 1014-16.

A study of the spontaneous reduction of hexachloroiridate(IV) to the +3 state in aqueous solution has shown that the reduction is due to reaction of the $IrCl_6^2$; with water to liberate oxygen. The reaction rate increases with increasing pH. Qualitative identification of reaction products was obtained by mass spectrometry and spectrophotometry. Quantitative measurements of evolved oxygen were obtained by vapor phase chromatography.

OL 1329

Fischer, J. E. "Modification of the Silicon Absorption Edge by Radiation-Induced Defects," Comments and Addenda, PHYS REV, Vol. 181, No. 3 (May 1969), pp. 1368-69.

We suggest that this phenomenon may be explained by an internal Franz-Keldysh mechanism.

OL 1330

Fletcher, Aaron N. "The Effect of Carbon Tetrachloride Upon the Self-Association of 1-Octanol," J PHYS CHEM, Vol. 73, No. 7 (July 1969), pp. 2217-25.

Spectrophotometric evidence is presented for the existence of a 1:1 complex between carbon tetrachloride and the monomer of 1-octanol absorbing at the wavelength of the monomer (1.41 μm). The nonbonded solvent "free" monomer concentration was calculated from the concentration of the cyclic self-association tetramer using equilibrium constants previously determined with n-decane as the solvent. The concentration of the CCl_4 "bonded" portion of the monomer was determined by difference from the total monomer concentration. The 1:1 complex is explained on the basis of an O-H. . .Cl hydrogen bond with CCl_4 serving as the proton acceptor. The equilibrium constant between CCl_4 and 1-octanol was determined at 5, 30, and 45° over the complete range of possible concentrations. The formation of the 1:1 complex was found to have a small enthalpy change (~ -0.5 kcal mol^{-1}) and an average equilibrium constant of 0.096 ± 0.001. Although 0.096 is rather small, it effectively changes the total monomer-total self-association tetramer equilibrium quotient from a value of 774 M^{-3} in n-decane down to 50 M^{-3} in CCl_4 at 25°. Thus the true equilibrium constant for 1-octanol is 15 times larger than the quotient normally measured in CCl_4. Since only half of the monomer is solvent "free" in dilute CCl_4 solutions, previous hydrogen bond equilibrium studies involving O-H groups in CCl_4 are in serious error. This is particularly true where the degree of self-association was used to determine the self-association species. Calculations were also performed determining the concentrations of all major species in solution using just the added concentration of 1-octanol in CCl_4 and the derived equilibrium constants. For example, an average relative deviation of only 3.1% was found between the calculated and the measured concentration of the monomer at concentrations up to neat alcohol for 40 determinations at three different temperatures.

OL 1331

Fletcher, Aaron N. "The Effect of Hydrogen Bonding Upon the Autoxidation Kinetics of Tetrakis-(dimethylamino)ethylene," J PHYS

CHEM, Vol. 73, No. 11 (November 1969), pp. 3686-89.

The autoxidation of tetrakis-(dimethylamino)ethylene has an apparent negative, zero, or positive Arrhenius activation energy depending upon the concentration of the hydrogen bonding catalyst, 1-octanol. The Kinetics are both first and fourth order with respect to the 1-octanol monomer concentration. When the concentrations of the alcohol self-association species are considered, it is found possible to explain these results by a zero Arrhenius activation energy for both the acyclic self-association tetramer and the monomer. These results suggest that the acidity of the acyclic self-association species may be the important parameter in high-order alcoholysis rather than "solvation" of the reaction intermediate.

OL 1332

Fletcher, Aaron N. "Quinine Sulfate as a Fluorescence Quantum Yield Standard," PHOTOCHEM PHOTOBIOL, Vol. 9 (May 1969), pp. 439-44.

Samples of quinine sulfate or bisulfate from a number of vendors have been examined. The light absorptivity and fluorescence excitation spectra of quinine bisulfate prepared from six sources of hydrated quinine sulfate had satisfactory agreement with each other. The solid samples of quinine sulfate or bisulfate showed good agreement (2.2 per cent relative difference) in their fluorescence quantum yields but the one commercial solution of quinine sulfate was 20 per cent low. The relative fluorescence quantum yield of quinine sulfate was evaluated with excitation from 240 through 400nm and was found to have no unexplainable deviations from a constant value. It is suggested that some of the conflicting results in the literature may be due to the common practice of using a different spectral bandwidth for absorbance measurements than that used for excitation.

OL 1333

Forkey, David M. "Electron-Impact Induced Fragmentation of 2-Substituted 2H-Cyclopenta[D]Pyridazines," ORG MASS SPECTROMETRY, Vol. 2 (March 1969), pp. 309-15.

The mass spectra of the nonbenzenoid aromatic heterocycles 2H- and 2-methyl-2H-cyclopenta[d]pyridazine and several deuterated analogs have been analyzed. The majority of the nitrogen lost from these heterocycles occurs as HCN or H_2CN. The deuterium labeling suggests a rearrangement of the molecular ion prior to fragmentation.

OL 1334

Forkey, D. M., and W. R. Carpenter. "Mass Spectrometry of Methyltetrazoles," ORG MASS SPECTROMETRY, Vol. 2 (May 1969), pp. 433-45.

The mass spectra of tetrazole, all isomers of monomethyl- and dimethyltetrazole, several trifluoromethyl substituted tetrazoles, as well as deuterated analogs, were recorded. Loss of N_2 was the important fragmentation of the molecular ions of tetrazole and 2-methyl substituted tetrazoles; however, HN_2 loss was more important for 1-methyl substituted tetrazoles. The 1-methyltetrazoles exhibited an unprecedented [M + 1] peak with no molecular ion.

OL 1335

Glosser, R., and B. O. Seraphin. "Electroreflectance Observation of Internal Photoemission in InSb," Z NATURFORSCH, Vol. 24a, No. 9 (September 1969), pp. 1320-22.

Electroreflectance is being used to determine the character of InSb surface layers exposed to uv irradiation. On n-type surfaces, such irradiation induces a charge transfer from band states into trapping states in the oxide layer, and the surface converts to p-type. Relevant parameters of this charge transfer such as threshold energy and rate of thermal recovery are determined for different surface conditions and temperatures. The convenience of electroreflectance as a continuous monitor of surface processes in InSb is pointed out.

OL 1336

Green, A., E. Bauer, and J. Dancy. "The Influence of Impurities on the Formation of Single-Crystal Films," in Molecular Processes on Solid Surfaces, ed. by E. Drauglis, R. D. Gretz, and R. I. Jaffee. New York, McGraw-Hill Book Co., 1969. Pp. 479-97.

The influence of impurities on the nucleation and coalescence of f.c.c. metals on alkali-halide cleavage planes is discussed. The impurities may originate from the gas phase, the bulk of the substrate, chemical reaction, or by electron beam dissociation. Emphasis is placed on the coalescence process where impurity surface layers on the growing crystallites profoundly change their surface structure and the anisotropy of the free surface energy. The importance of the stacking fault energy is also stressed.

OL 1337

Hemingway, John C., and Ronald A. Erickson. "Relative Effects of Raster Scan Lines and Image Subtense on Symbol Legibility on Television," HUM FACTORS, Vol. 11, No. 4 (1969), pp. 331-38.

This experiment examined the relative effects of (1) image size and (2) number of TV raster lines making up the image upon an observer's ability to identify 16 different geometric symbols on TV. Four raster-line values per symbol height were each tested at three image angular subtenses. Eight subjects were told to identify 25 symbols for each of the 12 conditions; all had 20/12 near and far visual acuity or better. The forced-choice method was used; no limits were placed on response times. The results showed that (1) at least eight raster lines per symbol height and (2) a symbol subtense of 10′ of arc are necessary to obtain good symbol legibility on TV. An equation is developed from these and other data which quantifies the tradeoff between line number and angular subtense for different levels of performance.

OL 1338

Hightower, J. D., and E. W. Price. "Experimental Studies Relating to the Combustion Mechanism of Composite Propellants," ASTRONAUT ACTA, Vol. 14, No. 1 (November 1968), pp. 11-21.

Experimental studies relating to the combustion mechanism of ammonium perchlorate (AP) composite propellants have been conducted by utilizing simplified propellant geometries. Single crystals of AP and laminated, two-dimensional AP single crystal-hydrocarbon binder propellant "sandwiches" have been burned and quenched over a range of pressures applicable to rocket motor combustion conditions. Microscopic studies conducted on the quenched samples have yielded information on the nature of significant heat release mechanism occurring at or near the burning surface. Marked changes in the appearance of the surface of burned AP as a function of combustion pressure and type of ballistic modifier contained in the fuel-binder were observed. Studies utilizing a scanning electron microscope have shown significant differences in the physical structure of AP samples that have undergone low temperature partial decomposition as compared to those samples that were quenched from combustion. Strong evidence was found to indicate the existence of a thin decomposing melt on the surface of AP crystals under normal self-deflagration conditions. This evidence suggests that solid phase thermal decomposition may not contribute significantly to exothermic heat release near the burning surface. Microscopic examination of the burned sandwich profiles have shown the point of maximum regression to occur in the AP crystal a short distance from the oxidizer-binder interface. The surface contour across the interface was found to be smooth with no indication of significant exothermic interfacial reactions having occurred.

OL 1339

Ibiricu, M. M. "Stable and Unstable Regimes in Solid Propellant Combustion," in Proceedings of the 17th Congress of the International Astronautical Federation, Madrid, October 1966, pp. 183-89.

OL 1340

Jones, Philip E., Gerald B. Ansell, and Lewis Katz. "The Molecular and Crystal Structure of Bis(dimethyldithiophosphinato)nickel(II)," ACTA CRYST B25, October 1969, p. 1939.

The structure of bis(dimethyldithiophosphinato)nickel (II), $Ni[S_2P(CH_3)_2]_2$, has been determined from three-dimensional X-ray data collected by counter methods. The probable space group is $P2_1/c$; cell dimensions are a=9·261(6), b=12·004(8), c=11·016(6) Å, β=91·14(6)°. The observed density is 1·676 g.cm^{-3}, which agrees well with the density calculated for four molecules in the unit cell, 1·677 g.cm^{-3}. A three-dimensional least-squares refinement based on 1001 observed reflections led to a final R value based on F of 7·8% (weighted R=6·3%). There are two kinds of molecules in the unit cell, each with its nickel atom at a center of symmetry; thus, the NiS_4 groups are planar. The phosphorus atoms, however, are somewhat out of these planes. Though the two sets of molecules are independent they are structurally very similar. Ni-S bonds range from 2·229(5) to 2·242(5) Å, P-S bonds from 1·991(7) to 2·018(7) Å, and P-C bonds from 1·80(2) to 1·83(2) Å.

OL 1341

Joyner, Taylor B. "Explosive Sensitivity of Cobalt(III) Ammine Complexes," CAN J CHEM, Vol. 47 (July 1969), pp. 2729-30.

Unexpected uniformities in the explosive sensitivities of a number of coordination compounds have been observed. These suggest that the kinetics of reaction within the hotspot (as distinct from either generation of the hotspot or propagation from the hotspot to macroscopic proportions) play a critical role in determining the sensitivity of an explosive to initiation by impact.

OL 1342

Kinder, Floyd A. "Visual Control Using Wide Angle Displays (VISCON)," in Photo-Optical Techniques in Simulators Seminar Proceedings. Redondo Beach, Calif., SPIE Seminar Proceedings, Vol. 17 (28-29 April 1969), pp. 103-05.

Techniques of projecting fields-of-view up to 180° with a minimum of distortion are discussed. The basic system uses rear projection on a hemispherical dome to give realistic pheripheral vision to the viewer. The dome is curved to match the lens distortion, giving both low distortion and a wrap-around scene. Such a system is being developed for real-time remote control of aircraft, pilot briefing, and can also be used in a simulator

OL 1343

Krier, H., M. Summerfield, H. B. Mathes, and E. W. Price. "Entropy Waves Produced in Oscillatory Combustion of Solid Propellants," AMER INST AERONAUT ASTRONAUT J, Vol. 7, No. 11 (November 1969), pp. 2079-86.

The dynamic response of a flat solid-propellant flame to an oscillating pressure field was studied experimentally in a window burner fitted to a T-tube rocket motor that served as a pressure oscillator. The burned gas temperature was measured as a function of time (or phase) during a pressure oscillation, and also as a function of distance from the surface. Such instantaneous measurements of gas temperature, when coordinated with simultaneous measurements of pressure, provide a measure of the entropy content of each element of gas as it flows away from the flame. Since the entropy content of each element of gas is nearly conserved as it flows along, an *entropy wave train* is formed. It is possible to make deductions regarding the physics of the dynamic burning process by comparing the magnitude and phase of the observed entropy waves with the theoretical values predicted on the basis of a particular flame model. In general, the results show that the temperature of the gas flowing from the combustion zone responds neither isentropically nor isothermally to the pressure. Such responses were assumed in previous publications on the subject. However, on the basis of the KTSS model published recently, the magnitude and phase of the entropy wave are expected to vary in a more complicated form with the imposed frequency and the propellant properties. The observed waves reported in this paper tend to support these KTSS theoretical expectations.

OL 1344

Lepie, Albert H. "Forced Vibration Tester in Tension and Torsion for Plastic Materials Under Tensile Strain," REV SCI INSTRUM, Vol. 40 (August 1969), pp. 1004-07.

This paper describes an apparatus for applying simultaneously or alternately forced vibrations in tension and torsion on viscoelastic samples. The measurements can be made on unstrained or strained samples within a frequency range from 0.01 to 10 Hz. The temperature control of the sample is achieved either in an air circulating chamber or in a liquid environment. Typical results of measuring the dynamic moduli of a carbon black filled rubber in tension and shear are presented. The complex Poisson's ratio of filled rubber was calculated from its dynamic moduli as a function of strain.

OL 1345

Martin, Paul S., and Charles M. Drew. "Scanning Electron Microphotographs of Southwestern Pollen Grain," J ARIZONA ACAD SCI, Vol. 5 (March 1969), pp. 147-76.

OL 1346

Nielsen, Arnold T. The Chemistry of the Nitro and Nitroso Groups. New York, Interscience Publishers, 1969. Chap. 7, "Nitronic Acids and Esters," pp. 349-486.

OL 1347

Nielsen, Arnold T., and T. G. Archibald. "Intramolecular Reactions of Nitroolefin-β-Diketone Michael Adducts. Formation of 3-Oxo-2,3-Dihydro-4H-1,2-Benzoxazine and 4(5H)-Benzofuranone Derivatives," Tetrahedron, Vol. 25 (June 1969), pp. 2293-2400.

1,3-Cyclohexanedione (**3**) undergoes Michael addition to β-nitrostyrene in methanolic sodium methoxide to form 3,5-dioxo-4-phenyl-2,3,5,6,7,8-hexahydro-4H-1,2-benzoxazine (**5a**) With 1-nitropropene 3 forms the corresponding 4-methyl derivative (**5b**) These substances had been designated as 4-substituted 5-oxo-5,6,7,8-tetrahydro-4H-1,2-benzoxazine-2-oxides (**4a**, **b**) by other workers. 5,5-Dimethyl-1,3-cyclohexanedione (**9**) under similar conditions adds to β-nitrostyrene to form 2-(2-nitro-1-phenylethyl)-5,5-dimethyl-1,3-cyclohexanedione (**10**); **9** and 2-nitro-1-phenylpropene yield 3-phenyl-2,6,6-trimethyl-6,7-dihydro-4(5H)-benzofuranone (**12**). In other reactions various β-diketones add to nitroolefins to yield normal Michael adducts, 4-nitro-1-alkanones (**1**,**2**). Molecular ion fragmentation patterns and mechanisms of formation of the abnormal addition products are presented and their rationalizations discussed.

OL 1348

Nielsen, Arnold T., and T. G. Archibald. "Mechanism of the Kohler Synthesis of 2-Isoxazoline-2-Oxides from 1,3-Dinitroalkanes," J ORG CHEM, Vol. 34 (April 1969), pp. 984-91.

Formation of 3,4,5-triphenyl-2-isoxazoline 2-oxide (3) from 1,3-dinitro-1,2,3-triphenylpropane (2) has been shown to involve an intramolecular nitrite ion displacement in the intermediate 2 mononitronate anion. Contrary to the generally accepted mechanism for this reaction, it has been shown that a nitro olefin intermediate is not involved. 1-Nitro-1,2,3-triphenylpropene (13) has been synthesized from 1,2-dinitro-1,2,3-triphenylpropane by heating with ethanolic potassium acetate. In basic solution 13 forms a nitronate anion which undergoes rapid C-1 protonation to 3-nitro-1,2,3-triphenylpropene (16); no isoxazoline 2-oxide is formed from 13 or 16. A product described by other workers as nitro olefin 13 has been shown to be a stable molecular complex composed of two cis-α-nitrostilbene molecules and one trans-stilbene molecule. Additional evidence against a nitro olefin intermediate was obtained by reaction of 2 with sodium methoxide in methanol-O-d to form 3,4,5-triphenyl-2-isoxazoline 2-oxide-5-d, and reaction of cis-α-nitrostilbene-α′-d with phenylnitromethane in methanolic sodium methoxide to form 3,4,5-triphenyl-2-isoxazoline 2-oxide-4-d. The stereochemistry of 3 has been shown to be trans by reduction of it to known trans-3,4,5-triphenyl-2-isoxazoline. Mechanisms of isoxazole formation from 3 and alkane-1,3-bisnitronic acids are also discussed briefly.

OL 1349

Nielsen, Arnold T., and Donald W. Moore. "Base-Catalyzed Intermolecular Condensation of α,β-Unsatyrated Ketones. Self-Condensation of Styryl Isobutyl Ketone to Epimeric Diketones, $C_{26}H_{32}O_2$, and a Triketone, $C_{39}H_{48}O_3$. Stereochemistry of Michael Cyclization," J ORG CHEM, Vol. 34 (February 1969), pp. 444-50.

The self-condensation of styryl isobutyl ketone (1) in ethanolic sodium hydroxide solution leads to a cyclic diketone trimer, all-trans-3,5-diphenylisopropyl-4-(3-methylbutanoyl)cyclohexanone (2a), and a triketone dimer, 3,5-diphenyl-2-isopropyl-4-(2-isopropyl-7-methyl-5-oxo-3-phenyloctanoyl)cyclohexanone (4). In aqueous sodium hydroxide 1 produces an acyclic dimer, 1,5-diphenyl-4-isopropyl-9-methyl-1-decene-3,7-dione (3a), a compound shown to be a precursor of 2a. Pyrolysis of trimer 4 produces 1 and 2b, an epimer of 2a. Heating 2a in refluxing dioxane with sodium methoxide catalyst leads to a mixture of 2a, 2b, and a third cyclic dimer, 2c. The configurations of these condensation products have been established by deuterium-exchange experiments and nmr spectroscopy. The stereochemistry of the relevant addition reactions and a comparison with the related Michael aldol cyclization are examined and discussed.

OL 1350

Norris, William P. "Preparation of 3,3,6,6-d_4-Cyclohexa-1,4-diene," J ORG CHEM, Vol. 33 (December 1968), pp. 4540-41.

3,3,6,6-d_4-Cyclohexa-1,4-diene has been synthesized in 45% yield by a halodecarboxylation reaction on the Diels-Adler adduct of β-chloroacrylic acid and 1,1,4,4-d_4-buta-1,3-diene. The purity is about 98%. Because of the mild conditions employed neither scrambling of hydrogen nor isomerization to 1,3-cyclohexadiene occurs. The method appears to be generally suitable for preparation of substituted 1,4-cyclohexadienes.

OL 1351

Odencrantz, F. Kirk. "Freezing of Water Droplets: Nucleation Efficiency at Temperatures Above -5C," J APPL METEOROL, Vol, 8, No. 3 (June 1969), pp. 322-25.

Numerical values obtained in laboratory studies of nucleation effectiveness of pyrotechnically produced smokes are strongly dependent on experimental conditions. Contact nucleation is shown to be relatively important at warm temperatures, when the nuclei are produced in a supercooled cloud of high liquid water content. Thus, pyrotechnics designed to produce nuclei in supercooled clouds should be tested under appropriate conditions.

OL 1352

Odencrantz, F. K., and P. H. Hildebrand. "A Technique for Direct Measurement of the Size of Small Fog Droplets," J APPL METEOROL, Vol. 8, No. 2 (April 1969), pp. 301-03.

A technique for methyl-2-cyanoacrylate verification of ice crystals is shown to be useful for the replication of small fog droplets. The replica maintains the size and shape of the droplet, consequently does not require the determination of calibration factors.

OL 1353

Odencrantz, F. K., and L. E. Humiston. "Replicator for Ice Crystals," REV SCI INSTRUM, Vol. 39, No. 12 (December 1968), pp. 1870-72.

A vapor replicator for ice crystals is described. It is simple to construct and easy to operate in the laboratory or field. The dimensions are not critical. The most satisfactory temperature of operation and the filament current should be determined by trial operation. The replicator will also replicate water droplets and wet surfaces.

OL 1354

Parsons, B. J. "Band-Structure-Associated Aspects of Electroreflectance Spectra of Metals," Comments and Addenda, PHYS REV, Vol. 182, No. 3 (June 1969), p. 975.

OL 1355

Piller, H., B. O. Seraphin, K. Markel, and J. E. Fischer. "Electroreflectance of Disordered Germanium Films," PHYS REV LETT, Vol. 23, No. 14 (October 1969), pp. 775-78.

The transition from the crystalline to the amorphous state has been studied in germanium thin films by observing the electroreflectance spectra related to critical points at $\Gamma(E_0,E_0+\Delta_0)$, along the Λ direction $(E_1,E_1+\Delta_1)$, and at areas with Δ and Σ symmetry (E_2). A small shift of E_0 to lower energy with increasing disorder in the crystalline state, and weak structure in the amorphous state, have been observed. The spectral positions of $E_1,E_1+\Delta_1$ and E_2 do not change with disorder in the crystalline state but these responses are completely absent in the amorphous state.

OL 1356

Porteus, J. O. "Diffraction of Inelastically Scattered Electrons in Tungsten at Low Energies," in The Structure and Chemistry of Solid Surfaces, ed. by G. A. Somorjai. New York, John Wiley & Sons, Inc., 1969. Pp. 12-1/12-14.

OL 1357

Prentice, Jack L. "Scanning Electron Microscopy of BeO Whiskers Formed on the Surface of Burning Beryllium Droplets," Discussions and Notes, AMER CERAM SOC, J, Vol. 52, No. 10 (October 1969), pp. 564-65.

OL 1358

Price, E. W. "Recent Advances in Solid Propellant Combustion Instability," in Twelfth Symposium (International) on Combustion. Pittsburgh, Pa., Combustion Institute, 1969. Pp. 101-13.

Oscillatory combustion is a common, usually unwanted attribute of most types of high-capacity combustion systems. The highly concentrated energy release by chemical reactions is responsive to flow disturbances, and the resulting combustion disturbances can, under certain conditions, amplify the original flow disturbances. Because the combustion field ordinarily has only a limited supply of reactants in a condition prepared for combustion, a positive disturbance in combustion rate normally leads to a depletion of "ready" reactants and a consequent negative disturbance in combustion rate following the positive disturbance. Thus, the combustion tends to support periodic flow disturbances when "suitably matched." Because such oscillatory behavior is ordinarily undesirable, extensive research has been directed towards its understanding and elimination. In the case of solid-propellant rocket combustors, a number of previous reviews provide a general background of experience, methods, and knowledge. The present paper stresses advances since publication of the companion papers in 1964.

OL 1359

Price, E. W. "Relevance of Analytical Models for Perturbation of Combustion of Solid Propellants," Technical Notes, AMER INST AERONAUT ASTRONAUT J, Vol. 7, No. 1 (January 1969), pp. 153-54.

OL 1360

Price, E. W. "Review of the Combustion Instability Characteristics of Solid Propellants," in Advances in Tactical Rocket Propulsion, AGARD Conference Proceedings No. 1, April 1965, ed. by S. S. Penner. Maidenhead, England, Technivision Services, August 1968. Pp. 141-94.

Classes of instability behavior are reviewed and related to theory and to aspects of the combustion process. Experimental methods for small-scale testing of stability characteristics of propellants are described and typical results are presented.

OL 1361

Rees, Neville W. "The Adaptive Control of an Absorption Tower," in Institution of Engineers, Australia, Electrical Engineering Transactions, Vol. EE5, No. 1 (March 1969), pp. 35-38.

The problems of adaptive or optimal control of complex chemical systems are many. They include long time constants and time delays, high dimensionality, and nonlinearities. It is for this reason that a great deal of interest is being shown in sub-optimal control, which uses all the a priori knowledge of the system, quasi-linear dynamics, and instantaneous control policies. This paper describes such a scheme.

OL 1362

Ritchie, M. H., C. M. Drew, J. H. Rose, Jr., D. V. Sulway, and P. R. Thornton. "An Experimental Technique to Investigate the Structure, Composition, and Electrical Properties of Chemically Deposited Lead Sulfide Detectors," in Proceedings of the Second Annual Scanning Electron Microscope Symposium, IIT Research Institute, Chicago, Ill., 29 April–1 May 1969, p. 415.

Contoured conductive micrographs of chemically deposited lead sulfide infrared detectors are presented. The micrographs are maps of detector current under electron beam excitation at a constant bias, and show a nonuniform detector response pattern. A sharp peak in response at the interface of the photoconductor and negative electrode is described. The micrographs are compared to results obtained by Dutton using a fine light spot to determine the response properties of chemically deposited lead sulfied. The problem of relating the response pattern to the basic local parameters of the detector (local electric field, trapping characteristics, mobilities, lifetimes, etc.) is discussed. The major result of this work is to confirm the feasibility of this experimental approach.

OL 1363

Rockwell, R. E. "ITC/USA Range Report Naval Weapons Center, China Lake," TELEMETRY J, Vol. 4, No. 3 (April/May 1969).

OL 1364

Schadow, K. "Experimental Investigation of Boron Combustion in Air-Augmented Rockets," AMER INST AERONAUT ASTRONAUT J, Vol. 7, No. 10 (October 1969), pp. 1870-76.

Studies have been made using a windowed combustion tunnel to examine the mixing and burning between subsonic air and a supersonic fuel-rich exhaust of a rocket motor burning hydrogen-oxygen-boron mixtures. The reaction processes were recorded by high-speed cinephotography. Results of experiments are presented in which the following parameters were varied: 1) boron concentration in the propellant (up to 55% by weight), 2) nonequilibrium chamber temperature of the primary rocket (750°K to 2500°K), and 3) air to propellant flow ratio (3 to 15). The temperature of the primary rocket was calculated by assuming boron as a heat sink. These calculations showed good agreement with experimental data at low chamber temperatures. The strong influence of the primary nonequilibrium chamber temperature on the boron combustion efficiency was demonstrated using the results of particle sampling probes and c*-efficiency measurements. By increasing the chamber temperature from 750°K to 2000°K the over-all reaction efficiency was improved from 85 to 94%.

OL 1365

Seraphin, B. O. Optical Properties of Solids. New York, Plenum Press, 1969. Chap. 7, "Electroreflectance," pp. 153-78.

In the last two years it has been shown that for a number of insulators, semiconductors, and metals, a strong electric field at or inside the reflecting surface changes the reflectance of a solid in certain narrow ranges of photon energy. One can discuss many aspects of this electroreflectance effect relating it to electro-optics, to surface physics, or to band-structure analysis, to name just a few. This chapter focuses on the contribution of electroreflectance to the determination of the band structure of a solid.

OL 1366

Seraphin, B. O. "Electroreflectance and the Semiconductor Surface," SURFACE SCI, Vol. 13, No. 1 (January 1969), pp. 136-50.

Periodic modulation of the potential barrier inside the reflecting surface of a semiconductor results in a synchronous modulation of the reflectance. This electroreflectance effect is a function of the surface potential and can therefore be used as a reference property. Calibration of this reference against surface conductance or surface capacity in the field-effect or electrolytic version of the method, respectively, establishes the functional relationship and suggests surface investigations by strictly optical means. Quantitative interpretation of electroreflectance spectra in band structure analysis requires control over the potential distribution in the various space-charge regions. In the electrolytic method, strict conditions for polarization and modulation must be satisfied to make line-shape discussions of electroreflectance spectra meaningful.

OL 1367

Seraphin, B. O., and N. Bottka. "Satellite Structure in Electroreflectance Spectra," SOLID STATE COMMUN, Vol. 7, No. 6 (March 1969), pp. 497-500.

It is shown that line shapes of electroreflectance calculated for inhomogeneous perturbation of the reflecting medium agree quantitatively with surface-controlled measurements at the fundamental edge of germanium. Some conclusions are drawn for the interpretation of satellite structure in general.

OL 1368

Sewell, Robert G. S., and G. F. Kinney. "Response of Structure to Blast: A New Criterion," NY ACAD SCI, TRANS, Vol. 152, Article 1 (28 October 1968), pp. 532-47.

A fuel-air explosion, for example one from a gasoline vapor and air mixture, is characterized by the circumstance that the explosive energy is initially distributed and released throughout a relatively large volume. This contrasts with an explosion from a material such as dynamite, where the energy release is initially concentrated into a relatively small volume.

Important aspects of distributed-energy explosions include (1) how these explosions compare and contrast with concentrated-energy explosions, particularly with regard to respective damage potentials and (2) what constitutes a valid index or criterion for damage potential. Reported here are the results of both theoretical and experimental studies made in these connections. Excellent correlation between theoretical considerations and experimental measurements has been obtained, largely through a new damage criterion for blast damage potential. This new proposed criterion appears to have substantial utility in the study both of distributed-energy and of concentrated-energy explosions.

OL 1369

Whitnack, G. C., and R. Sasselli. "Application of Anodic-Stripping Voltammetry to the Determination of Some Trace Elements in Sea Water," ANAL CHIM ACTA, Vol. 47, (September 1969), pp. 267-74.

The application of anodic-stripping voltammetry, with a hanging mercury drop electrode and a fast-sweep polarograph, to the determination of several trace elements in raw sea water is discussed. Advantages and disadvantages of the technique and the main sources of error are described. A comparison is made of analytical data for the trace elements zinc, cadmium, lead, and copper by the anodic-stripping technique and by the single-sweep polarographic technique. Precise measurements of concentrations of 10^{-8}–10^{-9} M can be made, if variables are carefully controlled.

OL 1370

Williams, E. W., and Victor Rehn. "An Electroreflectance Interpretation of the $\Lambda_3 - \Lambda_1$ Transitions in InAs, GaAs, and (Ga,In)As Alloys," SOLID STATE COMMUN, Vol. 7, No. 7 (April 1969), pp. 545-48.

A consistent interpretation is applied to recent electroreflectance results for $\Lambda_3 - \Lambda_1$ transitiona in InAs, GaAs, and (Ga,In)As. An apparent discrepancy is removed and good agreement with recent theoretical calculations confirms the interpretation.

OL 1371

Woodman, Alan L., and Arnold Adicoff. "Vapor Pressure of Methyl-2-cyanoacrylate," J CHEM ENG DATA, Vol. 14 (October 1969), pp. 479-80.

The vapor pressure of methyl-2-cyanoacrylate has been measured over the temperature range -15° to 10°C. by means of a Knudsen effusion cell. The data fit the equation, $\log \rho\ (\mu) = 12.9536 - 3018.8/T$, and the heat of vaporization is 13.8 kcal. per mole.

PATENTS

U.S. Patent 3,276,379

Bonding Material for Propellant Grains, by Lawrence R. Dallett, NWC. 4 October 1966. Patent UNCLASSIFIED.

A method of building a solid propellant grain from a plurality of segments of propellant material, the segments being bonded or cemented together with an adhesive material of the same composition as that of the propellant binder.

U.S. Patent 3,308,935

Flexible Line Delivery Method and Device for Chemical and Incapacitating Agents, by Lawrence M. Biggs, Jr., NWC. 5 November 1968. Patent UNCLASSIFIED.

A device and method for effectively dispersing predetermined quantities of incapacitating agents over wide areas with dosage uniformity.

U.S. Patent 3,332,348

Non-lethal Method and Means for Delivering Incapacitating Agents, by Jack A. Myers and Clayton E. Panlaqui, NWC. 25 July 1967. Patent UNCLASSIFIED.

A device for delivering incapacitating agents from aircraft wherein a deflagrating compound is ignited in small submunitions and dispersed to cover a wide area for effectively saturating a preselected target area with a cloud of incapacitating agent.

U.S. Patent 3,340,641

Laser Range Finder Device, by Truman G. Bergman, NWC. 12 November 1968. Patent UNCLASSIFIED.

A lightweight laser system for use in range finders of the type which utilize reflected laser emission for purposes of determining range, i.e., observer-to-target distance.

U.S. Patent 3,351,627

Process for Synthesis of Vinyltetrazole Monomers, by Ronald A. Henry, NWC. 7 November 1967. Patent UNCLASSIFIED.

A process for synthesizing monomers from which polymers of high nitrogen content can be prepared which are soluble in a variety of solvents, compatible with single and double-base propellant formulations, and are useful as polymeric fuel matrices, and binders for composite propellants and explosives of various types.

U.S. Patent 3,353,965

A Method and Means for Enhancing Camouflaged Target Detection Utilizing Light Polarization Techniques, by Paul C. Driver and Robert E. Fowler, NWC. 4 November 1967. Patent UNCLASSIFIED.

A means for utilizing light polarization characteristics for enhancing target detection and identification by cancelling effects initiated through unpolarized light to subdue target background detail.

U.S. Patent 3,373,363

Discriminator Circuit Responsive to a Pulse Position Relative to a Gate Period, by J. S. Brugler and W. H. Woodworth, NWC. 12 March 1968. Patent UNCLASSIFIED.

A discriminator circuit for use in target systems of the type responsive to input pulse signals, and which circuit produces and error signal which is linearly related to the input pulse position relative to a synchronously timed square wave gate signal.

U.S. Patent 3,374,482

Radar Dish in Plastic Casement, by Leo L. Kielman, NWC. 19 March 1969. Patent UNCLASSIFIED.

A new and improved rotating canted radar antenna-dish encased in plastic whereby air pumping action is eliminated and mass unbalance is reduced to a minimum.

U.S. Patent 3,375,176

New Chemiluminescent Formulation, by Lee E. Humiston, NWC. 26 March 1968. Patent UNCLASSIFIED.

A waxy chemiluminescent material for use as a nighttime marking device.

U.S. Patent 3,379,010

Chamberless Rocket, by Edwin D. Harvey, Hercules Powder Company. 23 April 1969. Patent UNCLASSIFIED.

A solid propellant rocket which can be fired without an exterior metal casing.

U.S. Patent 3,379,796

Casting Propellant Charges, by W. N. Hewson and D. V. Clifford, Great Britain. 23 April 1968. Patent UNCLASSIFIED.

An improved method for casting propellant charges and to an application of the property of nitrocellulose powders to swell and coalesce into a coherent mass when treated with a suitable solvent and plasticiser; more particularly it relates to a base addition process of casting charges in which process the power is packed into a container and a suitable solvent under pressure is admitted to it through an orifice situated in the base of the container.

U.S. Patent 3,382,800

Linear Shaped Charge Chemical Agent Disseminator, by Lawrence M. Biggs, Jr., NWC. 14 May 1968. Patent UNCLASSIFIED.

A chemical bomb which uses explosive jets for forming a star-shaped aerosol cloud.

U.S. Patent 3,383,389

Process for Synthesis of Vinyltetrazole Monomers, by Ronald A. Henry, NWC. 14 May 1968. Patent UNCLASSIFIED.

A process for synthesizing monomers from which polymers of high nitrogen content can be prepared which are soluble in a variety of solvents, compatible with single and double-base propellant formulations, and are useful as polymeric fuel matrices, and binders for composite propellants and explosives of various types.

U.S. Patent 3,386,968

New Tetrazole Polymers, by W. R. Carpenter, NWC. 4 June 1968. Patent UNCLASSIFIED.

New tetrazole polymers derived from the condensation reaction of organic diazides with electronegative dinitriles.

U.S. Patent 3,392,672

Flare Lighter, by Ronald C. Noles, NWC. 16 July 1968. Patent UNCLASSIFIED.

A firing pin type ignition device designed to have the firing pin body fit into and block the ignition port and also hold aside the primer shutter when in the "safe" position, and adapted to be fired by application of a single slight unidirectional force.

U.S. Patent 3,392,673

Consumable Pyrogen Igniter, by Paul C. King, NWC. 16 July 1968. Patent UNCLASSIFIED.

An igniter constructed similar to a solid propellant rocket motor with an exhaust nozzle designed to maintain the igniter combustion chamber at desired pressure. Most of the igniter is consumed, eliminating dead weight to be carried by the rocket.

U.S. Patent 3,402,634

Instrument for Measuring Absolute Reflectance and Transmittance at Cryogenic Temperatures, by Harold E. Bennett, NWC. 24 September 1968. Patent UNCLASSIFIED.

An improved reflectometer for measuring absolute reflectance and transmittance of solid-state, single crystal samples at cryogenic temperatures.

U.S. Patent 3,412,403

Coil Antenna, by Carl I. Peters, Jr., NWC. 19 November 1968. Patent UNCLASSIFIED.

An antenna utilizing an inductor of a predetermined number of turns in which one or a group of more than one of these turns are shunted by a capacitor which may be variable and an R-F meter being in series with the capacitor in one embodiment thereof.

U.S. Patent 3,415,190

Anti-disturbance Fuse, by Otho E. Hart, NWC. 10 December 1968. Patent UNCLASSIFIED.

A self-destruct fuse with fluid escapement timing which is substantially constant irrespective of temperature variations.

U.S. Patent 3,417,455

Explosive Welding, by John Pearson, NWC. 24 December 1968. Patent UNCLASSIFIED.

An improvement in the process of explosive welding wherein the parts positioned with an angular gap in the area of the intended joint are coated with a buffer material prior to positioning of the explosive layer.

U.S. Patent 3,418,184

Smoke Producing Propellant, by Ronald F. Vetter, NWC. 24 December 1968. Patent UNCLASSIFIED.

A smoke producing composition particularly for use in influencing the weather. It comprises a mixture of Butarez, MAPO, trimethylol ethane trinitrate and aluminum preferably loaded with silver iodate.

U.S. Patent 3,419,628

Process for Preparing Fluorocarbon Monomers, by Martin H. Kaufman and John D. Braun, NWC. 31 December 1968. Patent UNCLASSIFIED.

Relates to new fluorocarbon monomers with high temperature stability for use in solid propellant grains.

U.S. Patent 3,420,175

Sequencing Switch, by Robert E. Swallow and Jerry R. Miller, NWC. 7 January 1969. Patent UNCLASSIFIED.

Electric circuit for use with aircraft carried dispenser which sequentially permits dispenser door to open and then allows ram air to enter same for discharging its contents.

U.S. Patent 3,420,474

Method for Collapsing an Aerodynamic Decelerating Vehicle, by Ronald C. Noles and Jimmie M. Craig, NWC. 7 January 1969. Patent UNCLASSIFIED.

A method for collapsing an aerodynamic decelerating vehicle, such as a balloon or parachute adapted to carry a payload, which comprises securing by suitable means to the apex of the vehicle a line or streamer of predetermined weight so that it hangs loosely over the outside of the vehicle. When the payload is delivered and the holder carrying the payload becomes less than the weight of the line, the vehicle tips over causing evacuation of the supporting air or gas and subsequent descent of the vehicle.

U.S. Patent 3,420,695

Process for Desensitizing Metallic Powders, by George B. Rice and Robert L. Dow, NWC. 7 January 1969. Patent UNCLASSIFIED.

A method for making particulate metal safe to handle in large quantities by coating the metallic particles with an organic elastomeric material. The desensitized metal powders thus formed are relatively insensitive to electrostatic discharge and practically non-toxic to handlers.

U.S. Patent 3,421,079

Measuring Thin Film Thickness Using Interferometric-Capacitance Technique, by Harold E. Bennett, Jean M. Bennett, and Edmond J. Ashley, NWC. 7 January 1969. Patent UNCLASSIFIED.

A method for measuring thin film thicknesses of metal or semiconductor oxide films, such as those which form spontaneously on metals in air or a similar atmosphere using an interferometric-capacitance technique.

U.S. Patent 3,423,942

Standing Detonation Wave Rocket Engine, by Clinton L. Spindler, NWC. 28 January 1969. Patent UNCLASSIFIED.

A propulsion system which employs a standing detonation wave for releasing thermal energy in a rocket nozzle.

U.S. Patent 3,425,353

Arming and Safety Mechanism for a Drag Chute Retarded Bomb, by Michael A. Halling, NWC. 4 February 1969. Patent UNCLASSIFIED.

Arming and safety mechanisms for explosive ordnance, and more particularly to such a mechanism for use with a drag parachute retarded small bomb, or "bomblet", in circumstances where the bomblet is intended to explode above the ground, and only if the parachute has properly functioned.

U.S. Patent 3,430,487

Propellant Spin Evaluation Apparatus, by Kenneth G. Thorsted, Louis C. Renner, and Joseph A. Schmidt, NWC. 4 March 1969. Patent UNCLASSIFIED.

A thrust motor test apparatus which measures thrust while the motor is spinning at a desired speed.

U.S. Patent 3,434,419

Rocket Assisted Projectile with Movable Piston Base Plate, by Robert M. Dimond, Genge, and Howard H. Payne, NWC. 25 March 1969. Patent UNCLASSIFIED.

The rocket motor of a rocket assisted projectile (RAP) is provided with a piston-type base plate to equalize the external pressure on the motor case wall during firing.

U.S. Patent 3,434,990

Accelerating the Cure Rate of Carboxylated Polybutadiene-Aziridinyl Compound Mixtures With Lithium Oleate, by Arnold Adicoff and Arnold A. Yukelson, NWC. 25 March 1969. Patent UNCLASSIFIED.

Lithium oleate is used to increase the cure rate of carboxylated polybutadiene by aziridinyl compounds.

U.S. Patent 3,435,140

Adaptive Control System for Airborne Television Camera, by Werner G. Hueber, NWCCL. 25 March 1969. Patent UNCLASSIFIED.

U.S. Patent 3,435,323

Magnetoresistive Modulator, by Harry H. Wieder, NWCCL. 25 March 1969. Patent UNCLASSIFIED.

A device for converting low-level DC signals into an essentially pure sine wave whose peak-to-peak amplitude is a linear function of the DC input signal by driving a thin film semiconductor magnetoresistive element in the gradient magnetic field of a permanent magnet; the magnetoresistor is mounted on a piezoelectric bimorph which is driven in its mechanical resonance mode.

U.S. Patent 3,435,549

Pump Type Tubular Magazine Repeating Gun, by Alfred F. Kermode, NWC. 1 April 1969. Patent UNCLASSIFIED.

Tubular magazine hand held pump type repeating grenade thrower with relatively short receiver and action, resulting from short bolt and bolt locking mechanism.

U.S. Patent 3,437,035

Method and Apparatus for Disseminating Fluid From Vehicle in Flight, by James E. Weimholt, NWC. 8 April 1969. Patent UNCLASSIFIED.

Aircraft launched chemical container in which dispensing openings are formed after launching by explosively cutting the openings in the wall of the container.

U.S. Patent 3,437,041

Supersensitive Impact Sensor, by Otho E. Hart and Samuel A. Miller, NWC. 8 April 1969. Patent UNCLASSIFIED.

Impact fuze for ordnance devices which initiates a detonator upon interruption of the light beam of a photo-voltaic cell.

U.S. Patent 3,437,534

Condensable Product Explosive, by William S. McEwan and Edward W. LaRocca, NWC. 8 April 1969. Patent UNCLASSIFIED.

An explosive composition which produces water soluble products and sharply defined underwater detonation aimed at providing a single-time pulse with increased explosive-energy yield and power.

U.S. Patent 3,437,752

Apparatus for Electron Smoothing in Image Dissector Tubes, by Holland C. Ford, NWCCL. 8 April 1969. Patent UNCLASSIFIED.

A dissector type low-light-level imaging tube system capable of storing an image indefinitely or integrating a stationary scene for any desired period having a target which simultaneously emits electrons and provides smoothing action, i.e., both provides image intensification and improves the signal to noise ratio of the electron image; the target being a thin film sandwich consisting of a dielectric, in which conduction is induced by electron bombardment, sandwiched between a thin metal conductor and a thin metal photoemitting grid.

U.S. Patent 3,439,610

Folding Munition, by Jack A. Myers, NWC. 22 April 1969. Patent UNCLASSIFIED.

A folding munition which may be mass-ejected from an airborne vehicle and be dispersed over a wide target area.

U.S. Patent 3,440,115

Shock-Gel Process for Preparing Plastic-Bonded Explosives, by Charles W. Falterman and Horace D. Stanton, NWC. 22 April 1969. Patent UNCLASSIFIED.

An improved process for preparing an acceptable molding powder of plastic-bonded explosives.

U.S. Patent 3,448,653

Quick Disconnect, by Jack A. Myers, NWC. 10 June 1969. Patent UNCLASSIFIED.

Tubular member telescopically receives an epoxy cemented member which is separated, when desired, by gas pressure in the tubular member. Prior to separation, an axial tensile load between the members is resisted by the shear characteristics of the cement. The wall of the tubular member is proportioned to the pressure so that it permanently expands slightly, causing the cement to progressively fail in tension.

U.S. Patent 3,450,155

Frictionless Relief Valve, by Warren P. Froehner, Robert E. Swallow, and Delbert W. Huffman. NWC. 17 June 1969. Patent UNCLASSIFIED.

A pressure release valve for maintaining control of a pressurized system and in which friction losses have been eliminated.

U.S. Patent 3,453,453

One-Shot Circuit With Short Retrigger Time, by Richard S. Hughes, NWC. 1 July 1969. Patent UNCLASSIFIED.

Provide a one-shot circuit having a variable period which is a hyperbolic function of an external d-c control voltage.

U.S. Patent 3,457,329

Inert Simulant Composition for a Plastic Bonded Explosive, by Wallace E. Silver and Jack Sherman, NWC. 22 July 1969. Patent UNCLASSIFIED.

An inert simulant formulation for a high explosive composition which has the density, thermal conductivity, and thermal coefficient of expansion of the duplicated explosive and also possesses equivalent physical strength, rigidity under stress, and machinability. This formulation provides inexpensive and safe testing of mock missiles and rocket warheads and other components utilizing high explosives.

U.S. Patent 3,460,507

Piston Expelled Chemiluminescent Water Signal Dispenser, by S. M. Little, S. Shefler, and M. E. McGowan, NWC. 12 August 1969. Patent UNCLASSIFIED.

Rescue and navigation aid providing a light source on the surface of water characterized by a canister containing chemiluminescent liquid which is hermetically sealed against entry of air and expelled by a piston actuated by a powder charge.

U.S. Patent 3,461,392

A Pulse Repetition Frequency to Direct Current Converter, by R. S. Hughes and C. E. McCall, NWC. 12 August 1969. Patent UNCLASSIFIED.

A device for converting a pulse repetition frequency signal to a direct current voltage. Incoming pulses trigger a flip-flop, the output of which drives a variable period one-shot. The outputs of the flip-flop and the variable period one-shot are summed, and the difference signal used to drive an integrator, the output of which is fed back to control the time period of the one-shot to make the time period of the one-shot equal to the time period of the flip-flop. The integrator output is a direct current voltage which varies as a function of the pulse repetition frequency.

U.S. Patent 3,462,709

Tunnel Diode Microwave Oscillator, by James Mitchell, NWC. 19 August 1969. Patent UNCLASSIFIED.

An apparatus for producing microwave electrical oscillations using a cascade circuit comprising tunnel diode negative resistance elements and distributed parameter capacitors and inductors.

U.S. Patent 3,468,256

Impact Fuse Assembly, by James L. Vanover, NWC. 23 September 1969. Patent UNCLASSIFIED.

An improved acceleration arming fuse for rockets operable at low angles of obliquity to soft targets such as water or marshes wherein the improvement comprises a newly shaped fuse housing and a deformable cup shaped member having a flat forward surface of considerably increased area which is readily crushable, thus rendering the firing pin operable.

U.S. Patent 3,469,401

Magnetic Colloid Propulsor, by William F. Hassel, Purdue University. 30 September 1969. Patent UNCLASSIFIED.

Method of producing an air thrust jet by introducing ferromagnetic particles into one end of the hollow core of an electromagnet, which accelerates the particles through the core, producing drag on induced ambient air, accelerating it through the core, and recovering the particles for recirculation, whereby only air is discharged from the other end of the core.

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