



MICROCOPY RESOLUTION TEST CHART NATIONAL BUREAU OF STANDARDS 1963 A





MC_EILE_CUPY

628

FINAL REPORT

ż

N00014-86-G-0216

Time Resolved Spectroscopy Facility for the Study of Nonlinear Optical Properties of Semiconducting Polymers

Principal Investigator: Professor A. J. Heeger

Institute for Polymers and Organic Solids University of California, Santa Barbara Santa Barbara, California 93106



DIE STATEMENT A Approved for public release Distribution Unlimited

Our picosecond transient spectroscopy facility is in full operation with sub-picosecond pulses (autocorrelation pulses yield about 300 femtosecond pulse widith). Pump/probe measurements of photoinduced bleaching, four-wave mixing experiments and third-harmonic-generation experiments are underway.

The items purchased are outlined as follows:

| ND-Yag Laser System Price includes: | | \$109,292 |
|---|-------|-----------|
| Laser Head, Power Supply, Frequency Doubler, Mode Locker System, Mode Locker Stabilizer, Pulse Compressor, Dye Laser and Accessories, Cavity Dumper, Power Supply and Electronic Chassis | | |
| Autocorrelator | | 9,381 |
| Oscilloscope and Accessories | | 18,503 |
| Chopper and Accessories | | 2,338 |
| Nonlinear Crystal for Difference Frequency Generation | | 2,041 |
| Closed Circuit Camera System (Black and White) | | 3,219 |
| Misc. Optical Components (i.e. Power Meter, Beam Steering, Lab Jack, X-Y Stage, Mirrors, Mirror Mounts, Prism, etc.) | | 3,976 |
| | TOTAL | \$148,750 |

RECENT RESEARCH RESULTS

ANISOTROPY OF $\chi(3)$ IN A DEGENERATE GROUND STATE POLYMER; <u>TRANS</u>-(CH)_X, M. Sinclair, D. Moses, and A.J. Heeger

We have measured the third order susceptibility associated with frequency tripling the fundamental of a Nd:YAG laser in various samples of polyacetylene. By measurement of the amount of third harmonic power reflected from a <u>trans</u>-polyacetylene sample relative to that from a sample of intrinsic silicon, we have determined the magnitude of $\chi_V(3)$ (all indices parallel to the chain direction) to be $\chi_{II}(3) = 945 \times 10^{-10}$ esu. Studies on

oriented samples indicate that $\chi_{II}({}^{3})$ dominates all other components of the $\chi_{II}({}^{3})$ tensor, consistent with the large nonlinear susceptibility being due to the conjugated π -electron backbone. We have also measured third harmonic generation in <u>cis</u>-rich polyacetylene samples. Here we find that the third harmonic power scales with the residual <u>trans</u> content; i.e. for a sample which -15% <u>trans</u>, we find the measured $\chi(3)$ to be 15% of the $\chi(3)$ for the fully isomerized <u>trans</u> sample. Hence $\chi(3)$ for the <u>trans</u> isomer is more than an order of magnitude larger than that of the <u>cis</u> isomer. This symmetry specific aspect of $\chi(3)$ implies a mechanism which is sensitive to the existence of a degenerate ground state, as in <u>trans</u>-(CH)_x, consistent with the virtual generation of nonlinear solitons as the principal source of the large measured third order nonlinear optical coefficient of polyacetylene.

MAG laser



A schematic diagram of the operational facility is as follows:

