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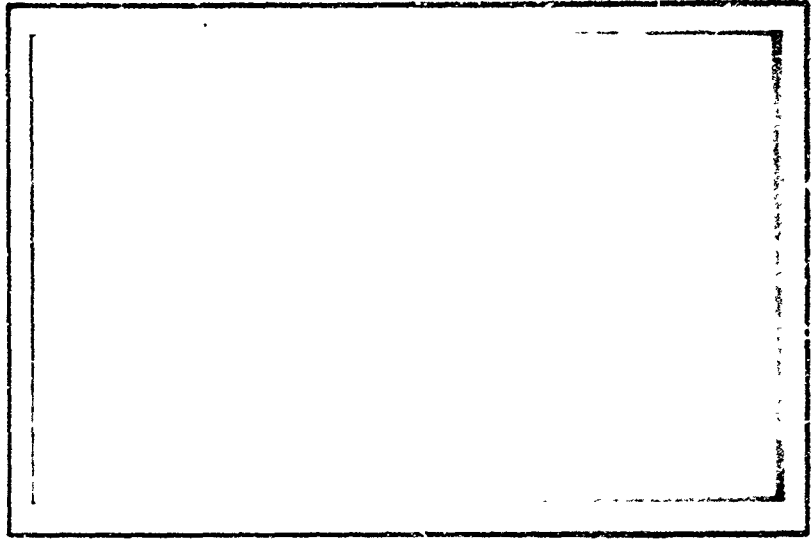
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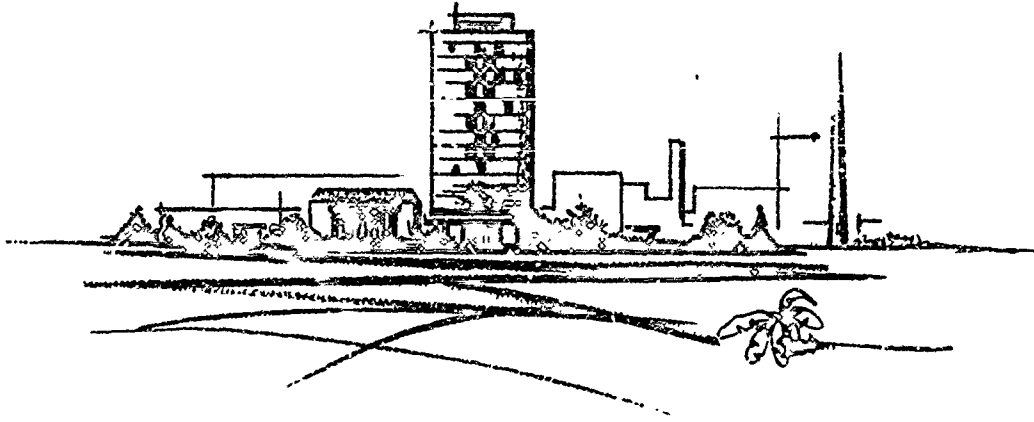
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RESEARCH REPORT



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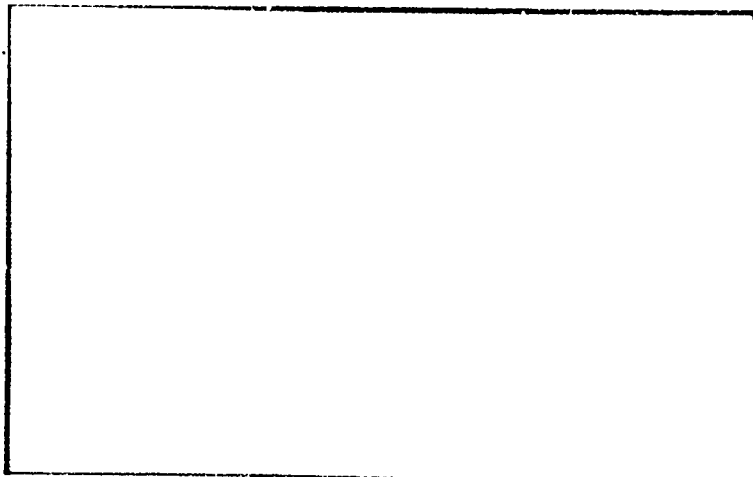
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FIELDS OF RESEARCH

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|------------------------------------|--------------------------------------|--------------------------------------|
| Aeronautics — Astronautics | Foundry Practice | Organic Coatings |
| Agricultural Chemistry | Fuels — Combustion | Packaging Research |
| Agricultural Economics | Glass Technology | Particle Dynamics |
| Alloy Development | Graphic Arts Technology | Petrochemicals |
| Applied Mathematics | Immunology — Cancer Studies | Petroleum Engineering |
| Area Economics | Industrial Economics | Pharmaceutical Chemistry |
| Biochemistry | Industrial Physics | Physical Chemistry |
| Biophysics — Bionics | Information Research | Production Engineering |
| Catalysis — Surface Chemistry | Inorganic Chemistry | Psychological Sciences |
| Ceramics | Instrumentation | Pulp — Paper Technology |
| Chemical Engineering | Light Alloys — Rare Metals | Radioisotopes — Radiation |
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| Computer Technology | Mechanical Engineering | Reliability Engineering |
| Corrosion Technology | Metal Fabrication Engineering | Rubber — Plastics |
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| Environmental Systems | Nonferrous Metallurgy | Thermodynamics |
| Extractive Metallurgy | Nucleonics | Transportation |
| Extreme-Temperature Technology | Ocean Engineering | Welding — Metals-Joining Technology |
| Ferrous Metallurgy | Organic Chemistry | Wood — Forest Products |

⑨ FINAL REPORT.

⑥ HIGH-TEMPERATURE PROPERTIES AND
ALLOYING BEHAVIOR OF THE REFRACTORY
PLATINUM-GROUP METALS.

⑮ Contract (Nonr-2547(00)), ⑫ NR-039-067

to

OFFICE OF NAVAL RESEARCH

December 17, 1965

⑪ 17 Dec 65,

⑫ 4 p.

⑩ ^{ter}
P. A. S. Rudman.
Metal Science Group

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December 17, 1965

Dr. W. G. Rauch
Acting Head, Metallurgy Branch
Office of Naval Research
Department of the Navy
Washington, D.C. 20025

Dear Dr. Rauch:

Contract Nonr-2547(00), NR 039-067

Enclosed are two copies of the Final Report on the project, "High-Temperature Properties and Alloying Behavior of the Refractory Platinum-Group Metals".

Please let me know if you have any questions or comments concerning the information in this report.

Very truly yours,



Peter S. Rudman
Fellow
Metal Science Group

PSR: tam
In duplicate
Enc. (2)

cc: Mr. Edward P. Shute (2)
ONR Resident Representative

HIGH-TEMPERATURE PROPERTIES AND ALLOYING BEHAVIOR
OF THE REFRACTORY PLATINUM-GROUP METALS

by

P. S. Rudman
Metal Science Group

↓
The occurrence of many phases in platinum-group metal alloys, or even more generally in transition metal alloys, correlates amazingly simply with electron/atom ratio or as we have preferred to call it, group number.

One example is the HCP structure that occurs in alloys in the average group number range 7-8.5. The axial ratio, c/a , ~~has been found to be~~ a sensitive

measure of the electronic state. ~~We have determined the~~ c/a -composition relationship in some 20 HCP alloys containing platinum-group metals. *was determined,*

The axial ratio appears to correlate well with phase stability: the smaller the axial ratio, the more stable the phase, with the HCP phase becoming unstable relative to cubic phases as c/a ~~approaches~~ *approaches* 1.61.

However, group number is not the only structure determining factor. Atomic size is also very important. The Laves phases appeared to be examples of where atomic size plays an important structure determining role. A theoretical study of Laves phases based on an elastic model was performed. This study appears to furnish some insight into the origin of Laves structures and sets the groundwork for a study of their stability.

Before we can hope to understand the structural changes that occur on alloying, we surely must understand the origin of allotropism in pure metals. Accordingly, a theoretical study of allotropism was initiated and is continuing. This study ~~has been~~ *was* very productive in providing clues to the phase-stabilizing factors. It has been tentatively concluded that the low temperature phases are generally characterized by a high density of states at the Fermi level and that the high temperature phases are characterized by high vibrational entropies. ↑

Publications in 1965

P. S. Rudman, "The Atomic Volumes of the Metallic Elements", Trans. AIME, 233, 864-872 (1965).

P. S. Rudman, "Atomic Volume in Laves Phases: A Hemisubstitutional Solid-Solution Elastic Model", Trans. AIME, 233, 872-878 (1965).

P. S. Rudman, "Lattice Parameters of Tantalum-Osmium Alloys", J. Less-Common Metals, 9, 77-79 (1965).