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SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS

Uranium Silicide (U_3Si_2)

Several synthesis experiments were carried out to provide a stock of U_3Si_2 powders for fabrication of test specimens. Using the technique of heating uranium metal and silicon to 1550°C. in a vacuum furnace in a magnesia crucible, three batches of U_3Si_2, weighing from one to three pounds, were synthesized. X-ray and metallographic examination indicated that the product was a good grade of U_3Si_2.

Using the above product, several bars (1/4-inch x 1/2-inch x 3 inches) and cylinders (1-inch x 1-inch) for physical tests were fabricated with a density of 11.8 grams per cubic centimeter (96.7% theoretical). The difficulty previously experienced in obtaining high density on the large test specimens has been overcome by increasing the sintering temperature from 1300 to 1400°C. (Argon atmosphere, see previous report for details).

Thermal conductivity specimens, which are cylinders with nominal dimensions of one-inch diameter and one-inch long, are being ground to size. Tests on these will be started in the near future.

Initial thermal expansion characteristics have been determined on U_3Si_2 bars (3-inch x 1/2-inch x 1/4-inch). This data indicates an average coefficient of thermal expansion of about 16×10^{-6} cm./cm./°C. over the temperature range of 30 to 1000°C. Further tests are being made to confirm this value.

Uranium Mononitride (UN)

During September considerable progress was made in uranium mononitride. Densities as high as 95 percent theoretical were obtained on the large specimens to be used for determination of physical properties. The procedure was to cold press at 16,000 pounds per square inch with Carbowax 6000 as the temporary binder, presinter in argon to remove binder, and then sinter in vacuum at 1850°C. for one hour.

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Metallographic examination of the sintered specimens has disclosed the presence of small amounts of a second phase believed to be uranium metal. It is thought that this is either a result of over-reduction of the higher nitride during the synthesis operation or loss of nitrogen during vacuum sintering. Experiments are in progress to explore both possibilities.

Bars of uranium mononitride, 3-inch x 1/2-inch x 1/4-inch, described above were used in preliminary thermal expansion tests using a high density silicon carbide tube dilatometer in a flowing argon atmosphere. An average value of 8×10^{-6} cm./cm./°C. was obtained over the range of 30 to 600°C. These results are only preliminary and will be extended to higher temperatures in future experiments.

Cylindrical specimens, 1-inch x 1-inch, for thermal conductivity tests, are being ground to size.

Uranium Monocarbide (UC)

In the previous monthly report it was noted that difficulty was experienced in obtaining high density UC bars for physical tests, although small pellets having a density of 95 percent of theoretical had been made. Additional work on sintering UC bars, 3-inch x 1/2-inch x 1/4-inch, during September resulted in densities of better than 93 percent of theoretical. The only change in procedure was to use freshly milled UC. Possibly the freshly milled powder is more active and therefore sinters more readily.

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