THE **CARBORUNDUM** COMPANY

RESEARCH AND DEVELOPMENT DIVISION P O BOX 337, NIAGARA FALLS, NEW YORK

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SYNTHESIS AND FABRICATION OF REFRACTORY URANIUM COMPOUNDS

1. Uranium Monocarbide (UC)

Several additional batches of uranium monocarbide were synthesized for use in fabrication of specimens for physical property determinations. A recent innovation has been to carry out the synthesis with mixed loose powders (UO_2 + C) in a graphite crucible as opposed to the pelletized reaction mix previously used. This has the advantage of yielding a UC clinker which is considerably softer and much easier to crush. X-ray and chemical analysis shows the product to be similar to that previously made from pelletized mix.

Additional bars, 3 inches by 1/2 inch by 1/4 inch, and cylinders 1 inch by 1 inch, were fabricated by cold pressing and sintering, for physical property tests. Densities ranged from 11.35 to 12.80 g./cc. (83 to 94 percent theoretical). The reason for the wide variation is not clearly understood. However, such factors as particle size and freshness of the milled UC powders appear to be important in determining the sinterability of UC.

2. Uranium Mononitride (UN)

Uranium mononitride has been synthesized during the past month using a stainless steel boat and inconel muffle furnace as described in the last quarterly report. This method has made it possible to produce 2 1/2 pound batches of UN. Analysis indicated the product to be single phase UN. Oxygen determination by vacuum fusion is being made.

Bars 3 inches by 1/2 inch by 1/4 inch, have been cold pressed and are currently being sintered for physical property tests.

3. Uranium Silicide (U_3Si_2)

It had been observed that there was some loss of silicide due to the violence of the reaction between uranium and silicon. Three batches of U_3Si_2 were synthesized during the past month with particular emphasis on controlling the rate of the reaction. In the synthesis of U_3Si_2, this

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was accomplished by limiting the maximum temperature to 1500°C. X-ray analysis of the product showed the major phase to be predominately U_3Si_2 with traces of UO_2 and silicon. Chemical analysis, including determination of oxygen by vacuum fusion is in process.

Additional specimens of U_3Si_2 for physical tests have been fabricated during the past month. Average density of about 94 percent of theoretical was obtained. This is somewhat lower than maximum densities previously obtained.

4. Evaluation of Sintered UC, UN and U_3Si_2 Specimens

Work on determination of physical properties has continued. Several more thermal expansion and modulus of elasticity tests were made. In addition, determinations were made of modulus of rupture, shear modulus and Poisson's ratio.

The modulus of rupture determinations were made at room temperature, 800°C., 1000°C., and 1200°C. using a two-point loading technique in an induction heated furnace. Values for the shear modulus have been determined using a sonic method. From the values of elastic and shear modului, Poisson's ratio has been calculated. Preliminary resistivity measurements have also been made, but it is felt that thin surface oxide layers may have effected the values and attempts are presently being made to study resistivity in an inert atmosphere. The preliminary thermal conductivity measurements are being made at this time and will be available shortly. Results to date of physical property measurements, which are of a preliminary nature, are summarized in Table I.

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TABLE I PROPERTIES OF SINTERED UC, UN AND U_3Si_2
(Preliminary Data)

Material	Density % of Theoretical	Thermal Expansion, cm./cm./°C.	Modulus of Rupture, 10^3 psi. 25°C.	800°C.	1000°C.	1200°C.	Modulus of Elasticity at 25°C. 10^6 psi	Shear Modulus at 25°C. 10^6 psi.	Poisson's Ratio
UC	83 - 94	11.3×10^{-6} (25 - 1200°C.)	10-15	15-20	10	Deformed	18 - 28	~8	.22 - .25
UN	81 - 91	~9.6×10^{-6} (25 - 1200°C.)	--	~15	--	--	20 - 24	8 - 10	.22 - .23
U_3Si_2	93 - 98	16×10^{-6} (30 - 1000°C.)	--	--	--	--	13 - 22	~9	.17 - .18

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