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Studies on the Reaction of Thorium with Graphite at High Temperatures*

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Abstract

The reaction of thorium metal with graphite was studied in the temperature range of 900°C to 1600°C. It was found that the reaction rate was parabolic and the activation energy for the reaction was 53 kcal/mole below 1200°C. Marker experiments showed that the growth of the carbide film was due mainly to the migration of carbon. From these results the rate determining process of the reaction seems to be the diffusion of carbon through the carbide film formed on the metal surface. Hydrocarbons, yielded by hydrolysis of the carbide film, were analysed by the gas-chromatographic method, from which the ratio of ThC/ThC₂ in the carbide film was determined. The film formed below 1200°C was composed of ThC only. However, in the film formed above 1300°C the ratio of ThC/ThC₂ decreased with increasing temperature. These results were confirmed by the X-ray diffraction technique. Parabolic rate constants for ThC and ThC₂ formations and apparent rate constants for the carbide film growth were obtained from the rate constant of the total carbide formation and the ThC/ThC₂ ratio in the carbide. The activation energy for the ThC₂ formation was found to be 120 kcal/mole from the results above 1300°C. The diffusion coefficient of carbon in ThC was calculated from the rate constants for the carbide formation. The amount of thorium carbide which forms in a thorium blanket of a graphite matrix fuel reactor was estimated.

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