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Kinetics of Some Metal Atom and Metal Fluoride Oxidation Reactions Relevant to Air Force Technology Development

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Abstract: This experimental work provides kinetic data on metal oxidation reactions for rocket propulsion and ramjet technology programs using the HTFFR (high-temperature fast-flow reactor) technique over the temperature range 300 to 1900 K. Mechanisms and rate coefficients were obtained from optical measurements of the consumption of metal atoms or metal monoxide radicals, as functions of pressure, oxidizer concentration, reaction time, and temperature. Rate coefficient measurements on the reaction of aluminum atoms with nitrogen trifluoride were made over the range 300 to 1000 K, and an Arrhenius expression derived. Above 800 K, gas chromatographic measurements show a thermal decomposition of the trifluoride. Experiments on aluminum monoxide (A10) reactions indicate that the O-A10 bond strength is probably greater than 126 kcal per mol. Magnesium atoms appear to react with molecular oxygen at 1900 K. Tests of means to vaporize elemental boron are reported. Thermal and microwave discharge dissociation of **diborane** and boron trichloride produce small quantities of atomic boron; these methods appear more suitable for generating boron monohalides or boron monoxide (in the presence of molecular oxygen). The accuracy of kinetic measurements on metal atoms at elevated temperatures is the subject of two of the publications resulting from this work. In one of these publications, HTFFR and other techniques for the study of gas-phase oxidation reactions are critically reviewed. (Author)

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