Thermodynamics-Based Materials Selection for Corrosion-Resistant Performance in High-Temperature Missile Propulsion Systems

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Corrosion-resistant materials are essential for the control of thrust magnitude and direction in missile propulsion systems. Thermodynamics-based models have been developed which provide an initial selection of corrosion-resistant materials for high-temperature propulsion components in solid propellant rockets and scramjets. The component wall temperature, and the combustion environment ambient pressure and oxidant activity are the critical variables for materials selection. Candidate materials for non-aluminized solid rocket propellant environments (with adiabatic flame temperatures up to 2700°C) include rhenium and the refractory compounds of zirconium and hafnium. Lower flame temperature propellants may allow the use of iridium and silicon carbide composites. Only tungsten is predicted to exhibit corrosion-resistance in aluminized propellants with adiabatic flame temperatures up to 3600°C. Oxidant gradients in the boundary layer of these propulsion components may broaden the candidate materials to include tungsten for non-aluminized propellants and tantalum carbide for aluminized propellants.