CERAMIC MATRIX COMPOSITE ENVIRONMENTAL BARRIER COATING DURABILITY MODEL

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Under NASA STTR Phase II funding, Materials Research & Design (MR&D) is currently enhancing a durability model for environmental barrier coatings (EBC) applied to ceramic matrix composites (CMC). The model treats the EBC as a porous material and tracks the flow of gases by solving the mass continuity equations. The model considers gas flux due to pressure gradient driven flow, or Darcy flow, and concentration gradient driven flow, or Fickian flow. Using the partial pressures of the oxidizing gas species, the model computes the rate of oxidation of the EBC. The presentation will discuss the successful Phase I program; specifically the ability to predict oxide thickness and stresses in the oxide layer. The presentation will also discuss the Phase II program which focuses on enhancing the model by including the silicon bond coat, allowing for stress to feed back into the oxidation model, and introducing direction dependent properties which are functions of stress, temperature, and amount of oxidation.

The experimental work is being conducted by Dr. Beth Opila (University of Virginia) and includes steam jet testing, steam cycling, laser-steam-load testing, ^{18}O diffusion studies, thermal expansion measurements, and grain orientation mapping. A description of each test and how it will be used to validate the model will be presented. Experimental data for tests which have been completed will be discussed and compared to the durability model wherever applicable.