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Damping Properties of Coatings at Elevated Temperatures

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ABSTRACT

The research reported upon in this paper is an evaluation of the complex modulus (both storage and lose modulus) of a TBC thin coating, 8% stabilized yttrium stabilized zirconium (8YSZ). The specimen incorporated is supported in a free-free fashion and placed in a vacuum chamber surrounded by 200W halogen lamps that allow for an isothermal temperature up to 482degrees C. The use of a free-free support and the vacuum chamber enclosure is meant to remove external agents which may inject overall effects on the loading dynamic properties. The dynamic excitation was developed with a series of permanent magnets placed strategically, creating a magnetic field developed with up to 7500 mA(7500 milli amps) current. In order to separate the combined effect of the base material (a titanium beam) from the coating, a method incorporating finite elements was carried out. A strain energy ratio (SER) was used equal to the amount of elastic energy stored in the coating over that stored in the metallic beam. The results led to the dynamic moduli. In order to determine these dynamic coefficients, a vibration ring down technique was incorporated requiring time to reach a steady state. A low value for the loss factor of about 0.02 exists that is applicable across all strain levels, temperatures, and amplitudes. The strain dependency can be approximated using a lower boundary form:

$\eta_c = 0.00621 \ln(\varepsilon_{11}) + 0.021; \varepsilon_{11}$ in micro strain In addition, it was found that 8YSZ is a strain softening material. The material is strongly nonlinear with room temperature values obtained close to those of previous work but varying in strain amount and amplitude of excitation. It has a storage modulus value of 30-35 GPa like other references. Similar to previous studies, much