



**Rogério Lima**, National Research Council Canada - NRC

***Manufacturing APS YbDS-based EBCs: Insights on Crystallization and Mechanical Behaviour***

**Authors:** Rogério S. Lima and Bruno M. H. Guerreiro, National Research Council of Canada (NRC)

**Abstract:**

Ytterbium disilicate ( $\text{Yb}_2\text{Si}_2\text{O}_7$ ) is a high-temperature rare-earth silicate primarily used to synthesize environmental barrier coatings (EBCs) via air plasma spray (APS). These types of coatings are engineered to protect SiC/SiC-based ceramic matrix composites (CMCs) employed in aviation gas turbine engines; specifically, from the corrosion caused by the high temperature water vapour atmosphere resulting from the combustion of kerosene. One of the challenges regarding the APS manufacturing of APS YbDS-based EBCs lies on the maximization of YbDS phase and its crystallinity, by minimizing silicon (Si) evaporation during spraying; at the same time promoting a desirable mechanical strength in the coating. In this paper, YbDS-based EBCs were produced via APS in the same way that regular porous APS thermal barrier coatings (TBCs) are fabricated; i.e., no assisted heating was employed during spraying. Spray parameters were tailored to minimize the evaporation of Si to mitigate the formation of ytterbium monosilicate (YbMS -  $\text{Yb}_2\text{SiO}_5$ ). A post-spray heat-treatment in air at different temperatures (1100-1300°C) and dwell times (from few to several hours) was employed to enhance the as-sprayed YbDS crystallinity levels from  $\leq 50\%$  to up 90%. After crystallization (heat-treatment), the YbDS levels were  $\geq 90\%$ , whereas those of YbMS were  $\leq 10\%$ . The mechanical behaviour (adhesion strength) of the as-sprayed and heat-treated YbDS-based EBCs was investigated via the ASTM C633 test. The results showed that adhesion strength increased from approximately 7 MPa as-sprayed to 14 MPa after heat treatment, with adhesive failure consistently occurring at the SiC substrate/Si bond coat interface.

**Biography:**

Dr. Rogério Lima obtained his PhD degree in Materials Science & Engineering (1998-2001) at the Center for Thermal Spray Research of the State University of New York at Stony Brook (USA); studying under the mentorship of Prof. Chris Berndt (now Distinguished Professor at Swinburne University of Technology – Australia). Right after his PhD graduation, Dr. Lima joined the Thermal Spray Team of the National Research Council of Canada (NRC) in 2001 as a Research Associate and was awarded permanent position in 2006. He currently holds the position of Senior Research Officer at the NRC. In 2022-2024, he served as the 15th President of the Thermal Spray Society (TSS) at ASM International. Dr Lima's main scientific interest is R&D of thermally sprayed thermal barrier coatings (TBCs) and environmental barrier coatings (EBCs) for aerospace applications.