In the last decades nanoindentation has consolidated as the most powerful tool to evaluate the mechanical properties of small volumes of materials, including second phase particles and thin films. Hardness and elastic modulus are the main properties evaluated using this technique. Furthermore, the potential of nanoindentation to explore a wider spectrum of mechanical properties and behavior at the micro/nano level, from the elastic to the elasto-plastic and fracture regimes, has been approached by means of using indenter tips of different geometries and sharpness. In addition, the nanoscratch technique has proven to be effective in the assessment of the structural integrity of coated systems through the evaluation of the coating damage and its adhesive properties. In this investigation, a complete evaluation of the mechanical behavior and structural integrity of a mullite-based Environmental Barrier Coating (EBC) on silicon carbide (3Al₂O₃·2SiO₂/SIC system) is carried out by means of nanoindentation and nanoscratch techniques. Nanoindentation tests using spherical, Berkovich and cube-corner tips were implemented to determine the intrinsic mechanical behavior of mullite in different coatings with constant and gradient compositions: indentation stress-strain curves, elastic limit ($\sigma_y$), elastic modulus ($E$), hardness ($H$) and fracture toughness ($K$) were assessed. On the other hand, using nanoscratch tests the structural integrity of the coated system (i.e. accounting for the film, interface and substrate influences) was evaluated through the energy of adhesion ($G_{int}$) and the interface fracture toughness ($K_{int}$). The overall results of mechanical behavior and mechanical behavior of these systems are key toward their effective implementation as EBCs.

**Keywords:** Nanoindentation, Nanoscratch, EBCs

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