Relationship between Microstructure and Composition of Plasma Sprayed Ceramic Oxides

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Atmospheric plasma spraying is a process in which particles are deposited on a substrate in a molten or semimolten state. Few studies were carried on optical properties about plasma sprayed coatings. Nevertheless, the specific microstructure combined with a wise choice on materials could bring alternative solutions in fields such as solar energy or aeronautic. The aim of this work is to study optical properties of plasma sprayed coatings, for wavelengths from visible to near infrared. To this end, alumina/aluminum cermet coatings were experimentally and numerically realized with different metallic rates ranging from 0 to 100%wt. Influent parameters (microstructure, roughness, crystallography, composition…) were emphasized. Composition and microstructure of the samples were carefully characterized to explain their optical response, highly dependent on volumetric and/or surface light scattering. Besides their contribution to the knowledge of microstructure, 2D SEM and 3D micro-tomography images were used to get statistical data in order to generate simplified numerical samples. A Monte Carlo ray-tracing model, based on geometrical optical laws, allowed to simulate material optical behavior and to reproduce experimental trends of optical spectra.