Abstract

The present investigation is undertaken to study the grindability aspects of air plasma sprayed ceramic coatings. Six ceramic coatings namely alumina, fine alumina, alumina – titania, titania, chromia and yttria stabilized zirconia were taken into consideration for this purpose. The powder morphology and the coating characteristics were studied under scanning electron microscope (SEM) and optical microscope. All coating demonstrated good microstructural integrity. The coating nanoscopic features were studied under transmission electron microscope (TEM). Equi−axed grains were found to grow in the plane of the coating. The coating porosity was found to depend on the melting point of the powder and also the powder size. All coatings showed tensile surface residual stress. The magnitude of this residual stress was found to depend on the elastic modulus of the coating material and coating defect density. After primary characterization of the plasma sprayed coating, the coated coupons were subjected to plunge surface grinding using precision grinding and high speed grinding machines employing single layer electroplated diamond wheels. Grinding forces, force ratio and specific grinding energy were studied. In both cases, the results pointed towards micro-brittle fracture to be predominant mode of material removal. This is further corroborated by short broken chip formation during grinding. The chip morphology did not change with variation in the grinding parameters like downfeed, workspeed and wheelspeed. The ground surface and subsurface was examined using SEM and focused ion beam assisted SEM, respectively. Signatures of micro- fracture was observed in both cases. The ground surface, as usual, harbor residual stresses. However, this stress, unlike metals, does not have a thermal origin. This is attributed to retention of material properties by the ceramic coatings at grinding temperature.

Keywords: plasma spray, ceramic oxide, powder morphology, high speed grinding, super abrasive, grinding chips, residual stress.