

Tool wear of DLC coating as top-layered to CrN, TiAlSiN, TiAlN coatings in machining of steel and aluminum alloys

Abstract

This study investigates the tribological performance of DLC top-layered coatings applied to surfaces of tools coated with CrN, TiAlSiN, and TiAlN. Double-layered coated tools (DLC/CrN, DLC/TiAlSiN, and DLC/TiAlN) were evaluated against single-layered (CrN, TiAlSiN, and TiAlN) and uncoated carbide cutting tools. The coatings were applied using the HiPIMS technique. Machining through orthogonal cutting under dry friction conditions with constant cutting parameters (240 rev/min speed, 2 mm cutting depth, 0.15 rev/mm feed rate) was performed on materials with soft ductile (aluminum) and hard, brittle (steel) characteristics. The coated tools exhibited approximately 20–30 % reductions in interface temperature, workpiece roughness, and chip thickness. The DLC top-layered coatings improved tool durability for machining both ductile and brittle materials, as evidenced in Raman analysis. Among the DLC coatings, DLC/TiAlN demonstrated the highest wear resistance and enhanced tool life, as confirmed by SEM-EDS analysis.

Keywords

Cutting tool; DLC coating; HiPIMS technique; Tribological performance; Wear resistance