An investigation of surface uniformity, chip formation and microhardness of magnetic field assisted diamond turning of titanium alloys

Jiuxing Tang, Suet To, Wai Sze Yip#

State Key Laboratory of Ultra-precision Machining Technology, Department of Industrial and Systems Engineering, The Hong Kong Polytechnic University, Kowloon, Hong Kong Special Administrative Region
Corresponding Author / Email: lenny.ws.yip@polyu.edu.hk, TEL: + 852 27666598

KEYWORDS: Magnetic field assisted diamond turning, Titanium alloys, Surface quality, Ultra-precision machining

Titanium alloys, renowned for their strength-to-weight ratio and biocompatibility, are significant in aerospace, biomedical, and automotive sectors. However, their low thermal conductivity and elastic modulus pose machining challenges in ultra-precision machining (UPM). This study explores Magnetic Field Assisted Diamond Turning (MFDT) to address this, aiming to enhance the machinability of Ti-6Al-4V alloy machining in ultra-precision machining (UPM). The results suggest that continuous and narrow chips are formed in applying the magnetic field, while under non-magnetic field conditions, the chips present discontinuous and cracks. Surface roughness analysis revealed the localized roughness area decreased to a consistently even finish at the surface center under magnetic field influence, indicating of improved surface uniformity. Finally, MFDT produced a consistently stable microhardness distribution from the workpiece edge to the center, unlike non-magnetic field conditions, emphasizing its impact on uniform material properties of a machined surface. This study contributes to improving the machining quality of titanium alloys by MFDT.