Study on fabricating of micro-pyramid array by precision diamond turning

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Abstract

As the demand for micro-patterned parts getting bigger, the need for molds with micro/nano scaled patterns to duplicate these parts effectively and economically is increasing ever so rapidly. Over the years, numerous attempts have been made to fabricate these molds using various approaches such as lithography, FIB, laser ablation, and precision diamond turning. Amongst these approaches, diamond turning is by far the most commonly used method to generate the micro patterned
rollers for roll-to-roll fabricating of precision optical parts such as BEF and 3D films. However, micro-burrs are frequently produced during the micro-cutting process which not only makes the mold un-usable but also increases the cost of machining. Efforts have been made to study the burr formation process during the micro-cutting by FEM simulation, micro-scratching and diamond turning. Influences of the machining parameters such as rake angle, cutting edge radius, included angle and cutting speed on the burr formation were systematically investigated. Array of micro pyramids
with 90o apex angle, 40*40μm2 basal area and minimised burr were successfully produced on a OFCu roller of 270mm in diameter. The results showed that (i) tool rake angle, included angle and cutting edge radius have profound effect on burr formation and achievable surface finish, (ii) simulation can supply very useful information for setting the machining parameters to suppress the burr formation during micro-cutting process.

Keyword：Micro-fabrication, micro-pyramid array, diamond turning, burr