Towards controlling the surface texture of machined features during spark assisted chemical engraving (SACE)

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ABSTRACT

Controlling the texture of micro-channels is vital for a plenty of applications, including solar cells, biomineralization, and scaffolds for growing cells. Furthermore, the significance of textured micro-channels on glass devices is purported to play a vital role in lab-on-chip devices and biomedical applications. Spark Assisted Chemical Engraving is a novel micromachining method capable of machining micro-channels on glass and ceramic devices while simultaneously texturing the surface. It was previously reported that, among other factors, the electrolyte concentration had the highest effect on the surface texture, where textures ranged from feathery-like to porous sponge-like as the concentration increased. Other factors included the tool speed and pulse-off time. An experimental setup has been designed and built to manufacture precision micro-channels using SACE technology and investigate the effects of different parameters on the surface texture. These parameters include the current and voltage signals, the electrolyte concentration and viscosity, the tool rotational speed, and the gas film characteristics, including gas film formation time, lifetime, and thickness. In this paper, the designed SACE setup is used to machine a range of microchannels with varying depths and investigate the effect of different AC voltage signals on the texture of the machined surface using different electrolyte concentrations. Furthermore, a correlation between the electrolyte concentration and electrolyte viscosity will be established that should help in better controlling the surface texture of machined channels.