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The importance of microstructure in electrochemical jet processing

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Abstract

Electrochemical jet processing (EJP) is an athermal technique facilitating precision micromachining and surface preparation, without recast layer generation. The role of the microstructure in determining machining characteristics has been largely overlooked. In this study, we show that in order to optimise EJP for a given material, fundamental material factors must be considered to ensure the desired near-surface response in terms of metallurgy, topography and dimensional accuracy. In this work, specimens have been prepared from the same feedstock material (brass, Cu39Zn2Pb), to appraise the role of microstructure in the determination of key removal characteristics, such as resultant topography, removal efficiency and form. Topography is shown to be highly dependent upon microstructure across large current density ranges, whereby the phase ratio is generally the dominant amplitude-defining material property, where preconditions with divergent ratios result in lower amplitudes. The microstructure, specifically the phase ratio, significantly changes the form, where predominantly single-phase conditions result in deeper and narrower features (up to 15% deeper compared with as-received condition). In addition, removal efficiency is greater (by 6%) at low current density for small grained dual-phase conditions, than for predominantly single-phase, due to erosion complementing anodic dissolution.