Prediction of Surface Roughness in Abrasive Assisted Electrochemical Jet Machining of Micro-Channels

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Abrasive assisted electrochemical jet machining (AECJM) is capable of fabricating micro-channels effectively at metal surface through erosion, corrosion and synergistic effect simultaneously. The complex mechanism of material removal results in significant difficulties to describe surface topography and predict surface roughness of a micro-channel produced by AECJM. This paper established a mathematical model for accurately predicting areal roughness (S_a) of micro-channels due to AECJM of SS304. Six main factors, i.e. working voltage (U), concentration of abrasive (C_a), electrolyte concentration (C_s), jet pressure (P), jet scan speed (V) and passes (N) have been considered in establishing the model. An orthogonal experiment was conducted to investigate the effects of the six main factors and two-factor interactions on S_a through regression analysis. The results reveal that the main factors influence the mean S_a with an importance of order as $V-N-C_a-C_s-P-U$. Working voltage, jet pressure and six two-factor interactions exhibit unmarked influences on the S_a , and have been eliminated from the model for purpose of simplification. The validation showed that the prediction agrees with experimental data with a maximum error of 12.2% and an average error of 3.5%.

Keywords: abrasive assisted electrochemical jet machining; electrochemical jet machining; micro-channel; surface roughness

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