Anodic Dissolution Model Parameterization for Pulsed Electrochemical Machining Coupled with a Magnetic Field

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Abstract

Manufacture of complex micro-scale parts such as biomedical devices and micro tools that require an excellent surface finish has required non-conventional manufacturing processes such as pulsed electrochemical machining (PECM). Additional reverse polarity pulses make the PECM bipolar and can assist the passivated electrochemical performance. The process can be further assisted with magnetic field Lorentz forces that drive a magnetohydrodynamic (MHD) electrolyte flow. Modeling the effects of bipolar pulsed electrochemical machining (PECM) in a magnetic field is a necessary step in defining a design methodology that can potentially guide the machining process efficiently in this complex parameter space. The geometry in this cell type is determined on a time scale much larger than the time scale that the electrical pulses occur. This requires the cell conductivity and efficiency to be parameterized for use in a COMSOL Multiphysics® simulation. Experiments used a 7075 aluminum workpiece in an NaNO3 electrolyte with a 316 stainless steel tool. The findings in this paper show the parameterization of the magnetically assisted PECM cell to model the effects on a large time scale.

Figures used in the abstract

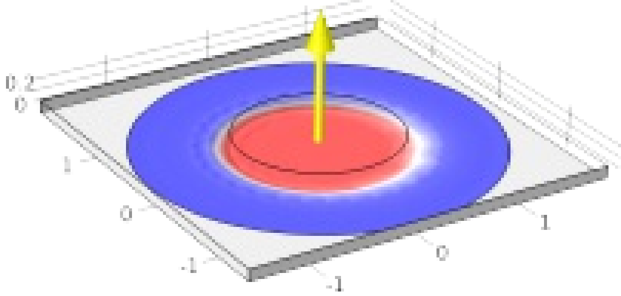

Figure 1: Dissolved surface overlaid with the current density and an arrow indicating electrical current flow