Electrochemical Machining with Nonsymmetric Suction of Electrolyte Flow

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Abstract

In electrochemical machining process, it is very important to control electrolyte flow field to remove contamination such as slug, or gas to be generated by the machining process as well as heat control for electrolyte, machining tool and work piece. To reduce the overcut of workpiece, special consideration is also needed for electric potential field within the electrolyte.
An electrochemical machining system with electrolyte flow suction has already been proposed by Natsu et al. ,and it is very interesting because that it can remove slug or gas efficiently ,while it can reduce the area of flowing electrolyte.
In this paper, electrochemical machining tool with suction devices for electrolyte liquid is investigated numerically.
A modification of the shape of tool electrode is discussed based on finite-element analysis. At first we proposed a modification of electrode configuration which can improve the arrangement of electric lines and reduce the overcut of workpiece. Secondly, we also proposed nonsymmetric flow suction of electrolyte and the resulting flow field shows the possibility to efficiently sweep out slug from the surface of the maching tool.
The system configuration proposed here is illustrated in Fig.1(b). There are two pumps at the top of the electrode in order to pull out the electrolyte within the machining area. Electric field within electrolyte is analyzed based on the conservation of current. The deformation of solid surface of workpiece due to electrochemical machining is treated by moving mesh technique with the mesh speed prescribed by Faraday's law, while the surface of maching tool is moved at constant speed by moving mesh technique. The governing equations are solved by using general purpose multiphysics analysis software, COMSOL Multiphysics® of Ver.5.2a.
Figures 1(e) and 1(f) show the electric fields at 4 seconds after the starting of machining process. Figure 1(d) compares the proposed method and the conventional method (Figs.1(a) and 1(c)) for y-coordinate along surface of the workpiece with 5 DC applied Voltage, and shows that the proposed type is more accurate. The flow fields of the proposed type are visualized, and no recirculating flow occurs on the surface of the central part of the tool.
Due to finite-element analysis by using COMSOL Multiphysics®, we proposed here a modification of electrode configuration in electrochemical machining system with suction device, which improves the machining accuracy of the workpiece and can be expected to sweep out slug or gas to be developed over the surface of the central part of the tool.

Figures used in the abstract

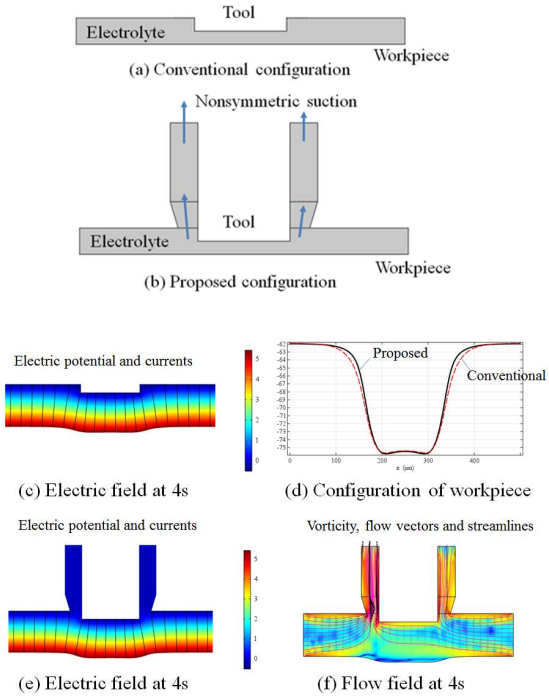

Figure 1: Propsed electrochemical machining and computational results.