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Global modeling of micro plasma discharge in deionized water SOHAM S. MUJUMDAR, Department of Mechanical Science and Engineering, University of Illinois at Urbana Champaign, DAVIDE CURRELI, Center for Plasma-Material Interactions, University of Illinois at Urbana Champaign, SHIV G. KAPOOR, Department of Mechanical Science and Engineering, University of Illinois at Urbana Champaign, DAVID RUZIC, Center for Plasma-Material Interactions, University of Illinois at Urbana Champaign — One of the major applications of plasmas in liquids is the micro electro-discharge machining process (μ-EDM) where the material from one of the electrodes is removed by creating repeated pulsed plasma discharges in the inter-electrode gap filled with a dielectric liquid. One of the most commonly used dielectric for the process is deionized water. A model of a single plasma discharge event in deionized water during the μ-EDM process is presented in this paper. The plasma is modeled using a global modeling approach where the plasma is assumed to be spatially uniform, and equations of mass and energy conservation are solved together in conjunction with the expanding plasma bubble dynamics. The model is simulated for different combinations of the applied electric field and the discharge gap distance to obtain complete temporal characterization of the H_2O plasma in terms of the composition of the plasma, temperature of the plasma and the radius of the plasma bubble. The model predicts time-averaged plasma temperature in the range of 12282-29572 K and electron density in the range of $5.12 - 30.22 \times 10^{24}$ m^{-3} for applied electric fields in the range of 10 - 2000 MV/m and discharge gaps in the range of 0.5 - 20 μm.

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