Third Laureate
Applied Research

Project title: Design, Performance and Modeling of Nano Electrical Dis charge Machining Process

Researcher: Ghodrat Tahmasebipour(Ph.D.)

Abstract:

In this research project, with the aim of production of proper nano-tool for Nano-Electrical Discharge Machining (Nano-EDM) process, an automatic system was designed, manufactured and optimized. Using this system, effects of fabrication process parameters on the nano-tool characteristics were studied. Obtaining optimum levels of the fabrication process parameters by the Taguchi method, we fabricated nano-tools with the apex radius of 10 nm and aspect ratio (length to apex radius ratio) of 172. To perform the Nano-EDM process, a suitable system was designed and fabricated. Using this system, and with optimization of the Nano-EDM process parameters, nano-craters with the radius of 50 nm and depth of 100 nm were machined in time of 4 nanoseconds on the surface of gold nano-layers. Therefore, in this research, the Nano-EDM process was performed as innovative ultrafast nanomachining method. To predict the Nano-EDM process specifications, including radius of the nano-craters, plasma channel of the Nano-EDM process was modeled with fluid mechanics and heat transfer analysis of the plasma channel and to compute the thermophysical properties of the plasma, a statistical mechanical model was presented. By the Nano-EDM plasma comprehensive model, plasma channel radius, pressure, temperature, enthalpy per unit mass, density, and mass versus discharge pulse duration is calculated. Using this model, the required discharge pulse for machining nano-craters with desired radius is predicted too.