The Impact of Polyurethane Elasticity on the Gap between Polishing tool and Work Surface in Elastic Emission Machining Systems

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Elastic emission machining (EEM) is an atomic-scale polishing method. It achieves atomic-scale material removal through the chemical adsorption of nanoparticles onto the workpiece surface, resulting in an ultra-smooth finish. As a non-contact processing method, the gap between the polishing tool and the workpiece surface significantly influences the machining effect. Since the polishing wheels typically use soft polyurethane materials, the elastic deformation of the material during machining affects the control of the polishing gap. In this study, an EEM setup was established, and the expansion of the polishing tool at different rotational speeds was calibrated using a laser displacement sensor. Additionally, a surface roughness evolution model was established. Through elastic emission machining of monocrystalline silicon, a surface roughness of 0.2 nm in Ra was achieved. This work provides technical support for the design and process optimization of EEM systems.

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