ABSTRACT

Ultrasonic Vibration Assisted Machining (UVAM) has emerged as an alternative to produce high-precision components with exceptional levels of detail and smoothness. This method utilizes vibrations to generate relative motion between the cutting tool and the workpiece, resulting in high-precision cutting results. Vibrations in UVAM machining arise from the use of piezoelectric ceramics that generate ultrasonic vibrations. In order for these vibrations to be optimal, support is needed from the vibration tool design that is able to increase the level of deformation produced, namely the flexure hinge design. This deformation is also influenced by the type of flexure hinge used. One type of flexure hinge that is commonly used is the corner-filleted hinge, especially in use on vibration tools. Corner-filleted hinges are the most widely used type of flexure hinge and have an important role in increasing deformation in these applications. In this study, simulations using the finite element method were carried out to understand the response and mechanical characteristics of corner-filleted hinges under various vibration loading conditions. Based on the context that has been mentioned, the purpose of this study is to study the use of corner-filleted hinge designs on UVAM vibration tools. This study aims to identify the optimal combination of corner-filleted hinge design parameters, considering parameters such as radius, hinge thickness, and hinge length, each of which is explored with 5 levels of values. This study explores the ability of corner-filleted hinges to increase deformation and minimize stress through realistic vibration simulations, using the Design of Experiments (DOE) method, especially the Full Factorial method to combine design parameters. Thus, the results of this study are expected to contribute to developing optimal designs to increase deformation in UVAM machining.

Key word: Ultrasonic Vibration Assisted Machining, Flexure Hinge, Corner-filleted Hinge, Deformation, Finite Element Analysis