Multidimensional Micro Hole Fabrication Using a Hexapod Integrated with Nanosecond Laser

A. Bakan[1], Y. Karpat[1]

[1]Bilkent University, Turkey

aykut.bakan@bilkent.edu.tr

Abstract

Multidimensional micro holes are used in micro ignition systems such as micro converging-diverging nozzles. While such holes can be produced via Deep Reactive Ion Etching (DRIE), powder blasting, and micro ball end milling, these methods may require multiple processing steps on both sides of the work material. These production methods require co-axial alignment, which decreases productivity. This study presents holes drilled from only one side using a nanosecond pulsed laser and a hexapod with 6 degrees of freedom. The hexapod system positions the workpiece relative to the laser to drill multidimensional holes. When the hexapod platform is kept horizontal, the rotation axis of the hexapod and the laser beam become parallel. This configuration can be used to obtain cylindrical holes via the laser trepanning process. When the hexapod platform is rotated while keeping the laser beam angle constant, the rotation axis and laser beam intersect at a single point. A multidimensional hole can be machined by changing the location of this intersection point. The intersection point of the laser beam and the rotation axis can be continuously adjusted by moving the platform to obtain the geometry of the diverging section of the hole. Kinematic analysis of the hexapod by considering the multidimensional hole geometry has been studied in this paper. Dimensional accuracy and surface topography of the multidimensional holes have also been investigated. Figure 1 shows the general overview of the system and the multidimensional holes obtained by using it.

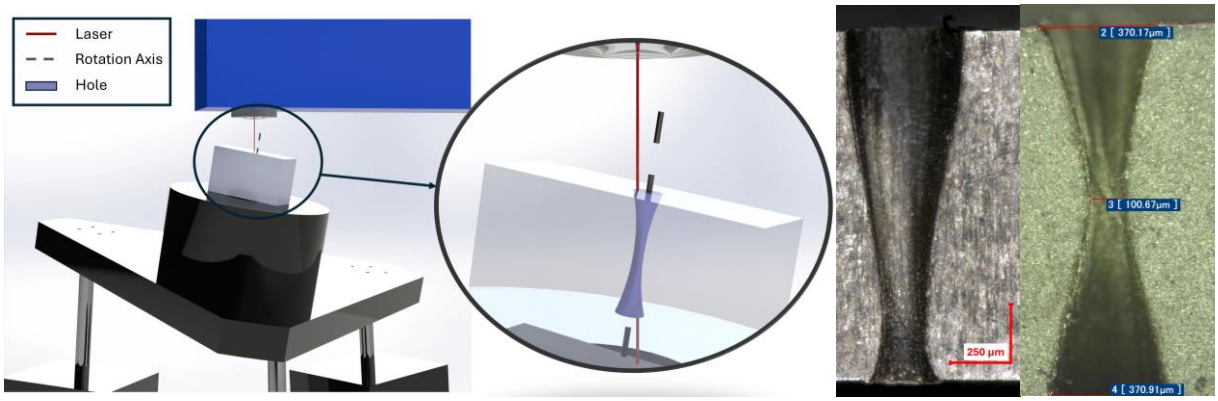

Figure 1: Multidimensional Hole Drilling Strategy and the Resulting Holes.