PURDUE INNOVATES | Office of Technology Commercialization

A Method of Drilling Non-Straight Holes Using Laser Ablation and Plasma Amplification

Laser ablation and plasma amplification (LAPA) is a fast, cost-effective manufacturing technique for creating precise, non-straight microholes with varying diameters in both conductive and non-conductive materials for applications like aerospace and diesel engine fabrication.

Non-straight microholes with diameters varying with depth are needed for many important applications. However, it is still very challenging to drill non-straight microholes with arbitrarily varying diameters. Due to the very small-sized hole, it is very difficult to deliver laser beam energy directly to the microhole sidewall to change the diameter of the hole in a controlled way. Past work has been reported on drilling reverse tapered microholes through electrical discharge machining (EDM) and micro electrochemical machining (ECM); however, such techniques are limited to conductive materials.

Researchers at Purdue University have developed a novel manufacturing technique for creating non-straight microholes called laser ablation and plasma amplification (LAPA). Its essential physical process is the interaction among a picosecond laser pulse, plasma generated by a prior nano- or picosecond laser pulse, and a microhole sidewall. LAPA promises a solution for fast, cost-effective, high-quality manufacturing of non-straight microholes with arbitrarily varying diameters. This will have a broad impact on many related areas such as fuel efficiency improvement and the reduction of toxic gas emission to the environment.

Advantages:

-Perform machining operations that were previously impossible

-Faster than existing methods

-Create precise holes in non-conductive materials

Potential Applications:

Technology ID

2015-SHIN-67218

Category

Automotive & Mobility Tech/Fuel Injection & Combustion Control Systems

Chemicals & Advanced Materials/Materials Processing & Manufacturing Technologies

Authors

Yung C Shin

Further information

Aaron Taggart

adtaggart@prf.org

View online

-Diesel engine fuel injector fabrication

-Aerospace engines

-Precision manufacturing

TRL: 2

Intellectual Property:

Provisional-Patent, 2015-07-30, United States | Utility Patent, 2016-07-28, United States | DIV-Patent, 2018-08-19, United States | DIV-Patent, N/A, United States

Keywords: laser ablation and plasma amplification, LAPA, non-straight microholes, arbitrarily varying diameters, picosecond laser pulse, plasma amplification, microhole manufacturing, non-conductive materials machining, diesel engine injector fabrication, aerospace engine manufacturing, Lasers, Materials and Manufacturing, Mechanical Engineering