

# Study on Three-dimensional Micromachining Using Synchrotron Radiation Etching

Nobuyoshi Nishi, Takanori Katoh\*, Hiroshi Ueno  
and Susumu Sugiyama

## Abstract

In this paper, we proposed a new approach of three-dimensional (3-D) micromachining without using any masks. This approach is a direct writing using synchrotron radiation (SR) etching. Several approaches to fabricate 3-D microstructures using photo-lithography have been proposed. However, these approaches are limited to fabricate microstructures due to the using mask process. SR etching is a dry process, and the etching rate of PTFE (polytetrafluoroethylene) is so high (100  $\mu\text{m}/\text{min}$ ) in vacuum using the SR white light. By utilizing a high processing speed and smoothness of the etched surfaces, SR etching might have a potential for 3-D micromachining by combining the direct writing with a stage having a high degree of freedom. Here, we reported the results of 3-D micromachining of PTFE using SR etching in vacuum and examined the dependence of SR etching of PTFE on the etching environment under an atmospheric pressure of He.

---

*Faculty of Science and Engineering, Ritsumeikan University, Kusatsu, Shiga  
525-8577, Japan*

*\* Sumitomo Heavy Industries, Ltd. 2-1-1 Yatocho, Nishi-Tokyo, Tokyo  
188-8585, Japan*