

Laboratory of Advanced Science and Technology for Industry

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1. Introduction

Various research departments have been gradually added at the Laboratory of Advanced Science and Technology for Industry at Himeji Institute of Technology after construction of the laboratory in April 1994. Currently advanced research is being conducted under five standard departments and one special department for visiting researchers. The Department of Micro Systems came to be in February 2000 after I joined the university. Along with other staff in the department, including associate professor Yuichi Utsumi and research associate Harutaka Mekar, I am currently conducting research on microsystems through active use of the synchrotron radiation facility New SUBARU built in the laboratory.

2. New SUBARU Synchrotron Radiation Facility at Himeji Institute of Technology

The synchrotron radiation facility New SUBARU was put in-service in January 2000. The facility, which is the third largest of its kind in Japan, is primarily intended to help establish a new industrial technology foundation through advanced research focusing on optics and development in cooperation with businesses. Financially supported by the local government of Hyogo Prefecture, New SUBARU is housed within the same complex as SPring-8, the world's brightest synchrotron radiation facility. But while the two facilities have an impact on each another, New SUBARU is a unique facility both domestically and overseas for the fields of soft X-rays and vacuum ultraviolet light sources in the strong emphasis it places on industrial use.

Already seven beam lines are currently in use. Fig. 1 shows the overall layout of the facilities. The storage ring has a circumference of 119 meters, a beam energy of 1.5 GeV, and a stored current of 500 mA. Beam line 11 (BL11) is dedicated to microsystem processing and is used to perform deep X-ray lithography in the LIGA process.

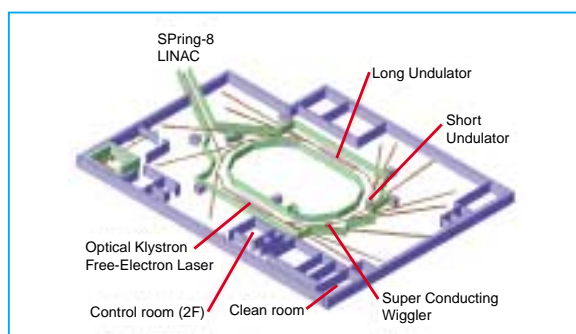


Fig. 1 The synchrotron radiation facility New SUBARU

3. Department of Micro Systems

Studies on the LIGA process are conducted at nearly every research institute having a radiation facility. However, few links have been made to industrial applications as of yet, even though such research has been conducted for more than twenty years. Recent trends in research on LIGA processes can probably be classified under the following three categories.

- (1) Studies on producing structures with a high-aspect ratio (height/width) using high-energy soft X-rays
- (2) Studies on producing 3D structures
- (3) Advanced and practical studies on electroforming and molding processes important in post-lithography manufacturing

America and Europe in particular emphasize (1) above because a high aspect ratio increases the specific surface area of the structure, providing various advances in functionality. However, (2) and (3) are more important for making realistic advances in industrial applications. In effect, we are striving to create 3D microstructures of desired shapes using LIGA, which can only create simple, cookie-cutter shapes, while reducing production costs and expanding material selections. Through our effective policy designed to establish all processes, from developing an X-ray mask to mass-production of molds, we have succeeded in developing optical switches for broadband applications, optical devices for terminals, chips for bioanalysis, and essential components for various microsystems. While there are still a mountain of issues to overcome before we can achieve our goal of being the first to produce microfunctional structures having a dynamic range from nanometers to microns, we are moving forward one day at a time toward establishing a single base in Japan for radiation manufacturing.

If you are fortunate to have the time and means to take a trip, please visit us at the West Harima Science Garden City. Take a break from your everyday activities and tour the New SUBARU and SPring-8 facilities.

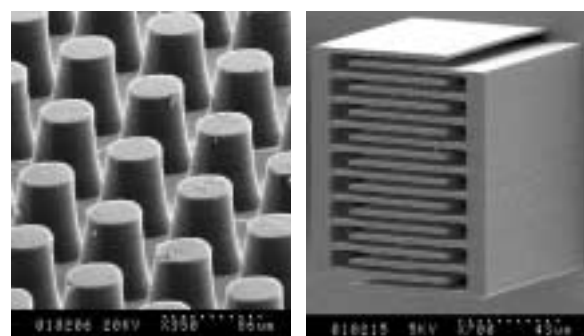


Fig. 2 PMMA exposure pattern

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