Worldwide R&D

Intelligent Formative Engineering, Department of Intelligent Mechanical Systems Engineering, Faculty of Engineering, Kagawa University

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1. Introduction

The Faculty of Engineering at Kagawa University is relatively new in that the first class enrolled in April 1998. Intelligent Formative Engineering, one research group in the Department of Intelligent Mechanical Systems Engineering, has focused on semiconductor microfabrication technology since its inauguration. We were granted permission to share the clean room in the Future Research Center On To The New Millennium KAGAWA (FROM Kagawa) in October 2000. Since then, we have been intensively studying micromachine technology. Professors Yutaka Mihara, Fumikazu Ohira, and I have been working together to raise funds and operate the clean room. This year we intensified our research activities by adding Research Associate Maho Hosogi to our group.

2. Research Facilities

We received permission to use the facilities at FROM Kagawa, including a Class 1000 clean room having an area of 70m^2 (see Fig. 1), two laboratories, a conference room, and a sitting room, for a total floor area in the five rooms of 300m^2. The clean room is equipped with photolithographic devices such as a two-sided mask aligner, draft chambers for treating organic and acid chemical wastes, an RF sputterer, a reactive ion etcher (RIE), and a STS-manufactured inductively-coupled plasma RIE, which we persuaded Kagawa Prefecture to install. Additional measuring equipment includes a measuring microscope and surface profiler. The electric furnace room is equipped with an oxidation furnace having an external combustion tube , a sintering furnace, an annealing furnace, and an SiN low-pressure chemical vapor deposition furnace. Except for an ion implanter , the facilities include all basic equipment required for research on semiconductor microfabrication.

Fig. 1 Class 1000 Clean Room (70m^2)

3. Research Themes

The research group of Intelligent Formative Engineering conducts numerous studies with a focus on the following topics.

- Micromolding
- MEMS-based optical communications
- Wearable sensors
- Microdevices for DNA analysis
- Probes for nanofabrication

In addition to conventional electroplating technology, micromolding research covers processing technology using superplastic titanium. MEMS-based optical communication research is the study of phase variable filters and optical switches that can maintain communication lines when electric power is interrupted. Under the theme of wearable sensors, a stethoscopic sensor is being developed for detecting vital signs.

Recently we have also turned our attention to bionanotechnology, working with Tokushima University and the University of Tokyo to establish microdisection for the specific isolation of DNA molecules from solution using a DNA nano pin set (see Fig. 2) and to fabricate prototypes of multi-nanoprobes for AFM field processing.

4. Conclusion

Owing to use of the clean room over the past three years, we have learned basic micromachining processes and production techniques for MEMS devices. We are committed to moving forward with our research in order to prove our competence as a MEMS research laboratory.

Fig. 2 DNA nano pin set, SEM photo of microdisectioned DNA cells (λ-DNA)

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