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産学官と高専機構が連携した「半導体人材育成事業」とプラズマ技術教育
Industry-Academia-Government and KOSEN Collaborated on the "Semiconductor Human Resource Development Project" and the Plasma Technology Education

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1. Introduction

Education for semiconductor engineering in Kyushu area of Japan is drawing increasing attention as TSMC has decided to make a factory in Kumamoto. Even though there are demands for human resources in the semiconductor field, there is no education that is intensive and systematic for the topic semiconductor. National Institute of Technology, or KOSEN, including Sasebo College has started education for semiconductor engineering from the April this year. Here, KOSEN is a system of education that is unique to Japan, where students learn from the age of 15 to 20, right after graduation of junior high schools. KOSEN's mission is to raise creative and practical engineers through the 5 years of specialized curriculum. There are total of 57 campuses, including both privately and publicly founded campuses, and over 60,000 students learn at KOSEN. In Sasebo College, we are constructing educational curriculum for semiconductor engineering to raise engineers who can be part of different and many areas of expertise in semiconductor industry. Since the goal engineers of this curriculum are meant to support wide areas of the semiconductor field, we refer to them as "volume zone engineers". In this paper, we would like to report the new courses and educational tools we have been constructing.

2. Practical classes by industry-academia collaboration

The fabrication of semiconductors or devices using semiconductors rely not only on electronic materials, but also on mechanical engineering, different material sciences, computer control systems, and many other fields of expertise. There is no systematic educational curriculum that cover all, or many at the same time, of these different fields. In Sasebo College, we have started a course where major part of the class is being taught by engineers who have been or are working in the actual industry. Figure 1 shows the actual curriculum. In the first semester, students learn the basics of semiconductors, the general use of the semiconductor devices, and their applications. In the second semester, students learn the general flow of semiconductor device fabrication. Prior to the actual classes, considerable amount of time was spent planning each class. Things such as the main topic of each class, the composition of the whole course, video contents which would drive students' attention further, time for group discussion for active learning environment were considered as the important elements of the course. Each element was planned and refined with both the KOSEN teachers and the lecturer. After every class, survey was carried out for the students. The feedback from the students were shared by the KOSEN side and lecturer side. The overall rating by the students was "satisfactory". Figure 2 shows the results of a questionnaire regarding changes in the conscious of students who took the course shown in Fig. 1 before and after the course. We were also able to confirm that more students were showing interest towards semiconductor field. This course is also planned to be open for other colleges of KOSEN through recordings and documents.

3. "One-phrase collection" for develop semiconductor-mindset

Raising and growing the mindset and interest toward semiconductor fabrication can lead to the increase in the number of students who choose to work in the semiconductor industry and more innovation toward semiconductor fabrication and application by the students. In the current curriculum, the relation between each subject and semiconductors are not clear. This leads to lack of students' attention to semiconductor. In order to solve this issue, we have organized a "one-phrase

Course Title	Introduction of Semiconductor Engineering (Elective / Credit / 1 credit) 90-minute class	
Period	First semester — Target Grade·Department — 4th year students, all departments	
Syllabus and lecturers 1	Guidance	Y. Hibino
2	History of semiconductors	H. Nakashima
3	Basic semiconductor properties: Crystal structure and band structure, classification of semiconductors and carriers	H. Nakashima
4	Practical semiconductor applications I: Discrete	Industry
5	Practical semiconductor applications II: Mixed-signal devices	
6	Practical semiconductor applications III: Integrated circuits	
7	Practical semiconductor applications IV: Optical semiconductors (Semiconductor lasers)	
8	Practical semiconductor applications V: Power semiconductors (Power electronics)	
9	Practical semiconductor applications VI: CMOS sensor	
10	Semiconductor manufacturing technology I : Design	University
11	Semiconductor manufacturing technology II: Front-end process	
12	Semiconductor manufacturing technology III: Back-end process	
13	Recent trends in semiconductor research	Y. Hibino
14	Field trip of semiconductor technology (1)	T. Ihara
15	Field trip of semiconductor technology (2)	T. Ihara

Fig. 1. The actual curriculum (Introduction of Semiconductor Engineering) .

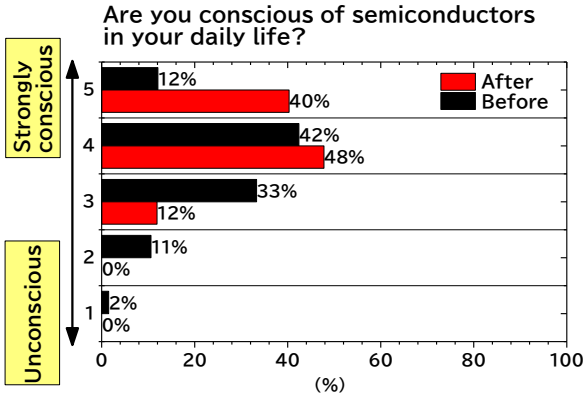

Fig. 2. The results of a questionnaire regarding changes in the conscious of students.

collection". This collection is composed various topics and phrases that relate different elements of semiconductor engineering with the on-going subjects that are being taught in Sasebo College. This collection allows teachers to present different topics on semiconductors during different subjects relatively casually, without making large modification to the curriculum. The teachers can look through the collection, find which topic best matches the current class he/she is teaching, and present the topic in the class which would take less than 3 min. Through the use of this collection students can nourish semiconductor-mindset and enables us to raise volume zone engineers for semiconductor industry. We are currently building the first version of the collection. This collection is also planned to be provided to all the colleges in KOSEN.

4. Development of delivery classes for elementary education

In Sasebo College, in cooperation with the local government, we have been starting classes on semiconductors in elementary education in order to promote early understanding of semiconductors and make them an option for the future. Figure 3 shows the photograph of the delivery class carried out at a junior high school in Sasebo City. In the class, group work asked students to think about semiconductor products all around us and gave them the opportunity to actually touch silicon ingots and wafers. The results of the questionnaire shown in Fig. 4 indicate that many students became interested in semiconductors after taking the delivery class. In the future, we plan to consider tie-ups with companies and expand this program in Nagasaki Prefecture.

Fig. 3. Photograph of delivery class.

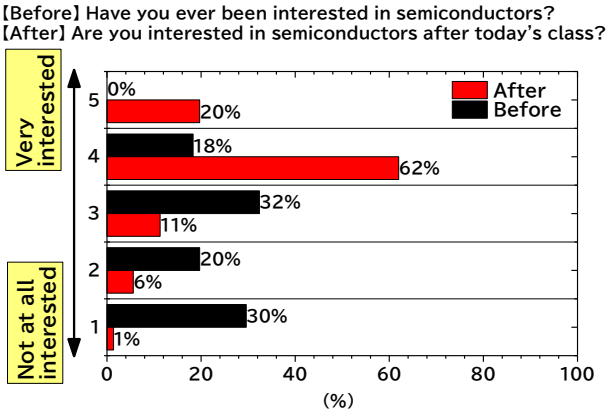

Fig. 4. The results of a questionnaire regarding interest in semiconductors of students.