Division of Electrical Engineering and Computer Science	Research field	Electronic Materials	Lab. ID EC14
Laboratory web site	http://lem1.w3.kanazawa-u.ac.jp/		

Research subjects

In ferroelectrics, electric polarization is produced by applying electric field and it remains as remanent polarization even after removing the electric field. The ferroelectrics are applied to memories, actuators, sensors. In our laboratory, layered structures using ferroelectric films, semiconductor films and electrode films are fabricated by various thin film preparation techniques, e.g., pulsed laser deposition (PLD), chemical solution deposition (CSD) etc., in order to develope nobel electron devices using the remanent polarization. Examples of the nobel electronic devices are ferroelectric photovoltaic cells and ferroelectric resistance memories.

Master/Doctor course: Education policy, curriculum, typical activity in the laboratory

The graduate students who belonged to our laboratory establishes the rough research themes by adivices from the supervisors, and starts their research in the group from April of M1 grade. A research theme of the indivisual student will be narrowed down in the course. The laboratory life in the early M1grade is highly occupied by attending the classes in the graduate course, but gradually shifts to research-based one. In the laboratory, an effective research activities are planned through the research group meeting with the supervisors and laboratory meeting with the supervisors on research results. In the laboratory seminar[″Seminar and Exercise″ in EEC], each student learns how to conduct literature survey and how to make technical explanation and discussion useful for conducting R&D. Throught the seminar, students learn the positioning of his/her research in the scientific and industrial society and deepen the research scientifically and technologically. The PhD student is expected that his/her research posture is more positive than M course student's one on preparing and executing of reseach project. Through such research activities, the graduate students are encouraged to present their results in domestic/international conferences and various reseach articles.

Daily life in the laboratory, etc.

Everyday life of the graduate students in our laboratory is mainly in the 4th floor of the Natural Science Hall 2A . For performing their experiment, not only laboratories of the Hall 2A fourth floor but also laboratories in the Advance Materials Science Laboratory (often called as VBL) are available in the same way. It is possible for graduate students to use various thin film deposition and characterization equipments in the laboratories after reading the manuals and receiving instruction from seniors. For getting reliable and reproducible experimental results, the graduate students are required to learn principles of operation of various equipments definitely.

Message or comments by the laboratory faculty staffs

Main graduate students of our laboratory are M course students, and the most of them take posts of technology development in electronic component makers, electrical equipment manufacturers, and wide manufacturing industries such as transportation equipment makers. The engineers in those posts are required to challenge new fields, act as the team, and act on their own initiative. The research activities in our laboratory are training for those jobs in industries.

Recent Master theses in these 3 years (+ more if appropriate)

year.month	Thesis title (including English translation of Japanese thesis title)
2017.3	Microfabrication of PZT ferroelectric films by water-lift-off using CaO films
2016.3	Development of diamond FET using organic ferroelectric gate
2016.3	Polarization-induced photovoltaic effect of BiFeO3 ferroelectric thin films doped with rare earth and/or transition metal elements
2016.3	Development of MoS2-FET with VDF/TrFE copolymer
2016.3	Fabrication of ferroelectric-gate β-Ga2O3 FET structure
2016.3	Investigation on characteristics of superconductivity in diamond using ferroelectric gate structure
2016.3	Resistive-switching of Nd-doped BiFeO3 ferroelectric thin films
2015.3	Development of diamond FET structure using ferroelectric gate
2015.3	Retention properties of BiFeO3 film capacitor for high-temperature operation
2015.3	Development of Field Effect Transistor using two-dimensional material for channel
2015.3	Development of new microfabrication technique for ceramics by using deliquescence material
2015.3	Development of engineered multiferroic materials using ferroelectric/magnetostrictive bilayered structure
2015.3	Fabrication and characterization of new resistance change elements using BiFeO3-based materials
2014.3	Study on transfer technology of ferro- and piezoelectric films
2014.3	Fabrication of rare-earth-doped BiFeO3 ferroelectric thin films and polarization-induced photovoltaic effect

2014.3	Fabrication and characterization of charge trap non-volatile memory device using Al-rich Al-O
2013.3	Fabrication of BiFeO3/diamond layered structure for high-temperature operation of FeRAM
2013.3	Fabrication and Characterization of MFIS Capacitor Structure with Ferroelectric (Bi,Pr)(Fe,Mn)O3 Thin Films
2013.3	Fabrication of BFO ultra thin film capacitors for low voltage operation FeRAM
2013.3	Fabrication of iron-based oxide thin films and their photovoltaic properties for solar cells
2013.3	Defect characterization of BFO ferroelectric thin films for improvement of their non-volatile memory operations
2013.3	The development of novel fabrication techniques for oxide electronic device using functional materials
Recent Doctoral theses in these 3 years (+ more if appropriate)	
year.month	Thesis title (including English translation of Japanese thesis title)
2014.3	Fabrication and characterization of non-lead ferroelectric BFO films and their application to nonvolatile memory
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