1. Title
FY2005 Ground-based Research Program for Space Utilization Research Report

2. Research Term
FY2005–2006

3. Research Field
Space Utilization Technology

4. Research Categories
Exploratory Research for Space Utilization

5. Research Theme
Investigation of Optoelectronic Devices Having High Irradiation Tolerance for Space Application

6. Investigators
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8. Summary of Research
In this project, irradiation effects on CuInSe₂ (CIS)- and GaN-based optoelectronic devices are investigated to clarify a fundamental behavior after the irradiation, together with a clarification of irradiation induced degradation of those devices, aiming a realization of the space optoelectronic devices having high radiation tolerance. Our primary approach, before starting this project, for the investigation of irradiation effects on CIS-based cells was focused on the single-crystalline thin films of CIS. In this project, we expanded our scope to the poly-crystalline films that is used in CIS-based solar cells. Recovering of electronic characteristics after the high energy electron irradiation by low temperature annealing were found in irradiated poly-CIS film. From electron spin resonance (ESR) study, Cu²⁺-related defect was found in e electron irradiated CIS. Furthermore, microscopic characterization using conductive atomic force microscopy (AFM), electron irradiation effects were
mainly found on the inside of the crystal rather than the poly-crystal interface. These results are useful for realization of a radiation tough solar cells. High energy electron/proton irradiation effects on GaN-based optoelectronic devices are also investigated. Investigations were made on commercially available LED and rare-earth ion (REI) doped GaN-related materials that is proposed by our group. From the electron/proton irradiation results, three orders of higher radiation tolerance was found for REIs-doped GaN. This feature suggests that the REI-doped GaN is promising for the radiation hard optoelectronic devices in space use, such as optical inter-orbit communications. For future researches, further investigation is needed to clarify the irradiation effects on CIS-based cells using microscopic characterization proposed in this project. We have started this investigation including annealing effects on irradiation induced defects using microscopic characterization. For GaN-based optoelectronic devices, device structure and the fabrication process should be investigated based on the REI-doped GaN-related materials, which possess a superior toughness against the irradiation. We have started this investigation including a designing of device structure, and a development of device fabrication process for realization of novel space optoelectronic device based on REI-doped GaN-related materials.

9. Publication List


10. URL
None