Requests for Collaboration

Name: Naoteru Shigekawa
Current position: Professor
E-mail address: shigekawa@eng.osaka-cu.ac.jp

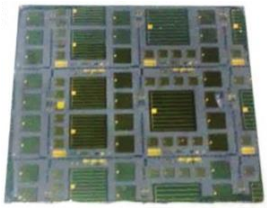
Research Interests

- Heterogeneous integration of foreign materials using low-temperature direct bonding technologies.
- Fabrication of novel green devices using heterogeneously-integrated materials.
- Characterization of bonding interfaces.

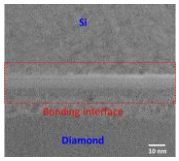
Scientific and Technological Achievements

(1) InGaP/GaAs/Si hybrid tandem (triple-junction) solar cells are fabricated by bonding III-V (InGaP/GaAs) epitaxial substrates to Si-based single-junction cell structures and applying device process. Conversion efficiencies of >26% are observed. Lower parasitic resistances and higher efficiencies are achieved by inserting indium-tin-oxide (ITO) films between III-V layers and Si.

(2) Single crystal diamonds are successfully bonded to Si substrates. Bonding interfaces show tolerance against high-temperature (1000 ℃) irrespective of large difference in coefficients of thermal expansion. The mechanism of the tolerance of interfaces is under investigation.



A Photo of triple-junction cells.



A TEM image of a diamond/Si interface.

Other achievements are shown on web. (http://shigekawa-ocu.jp)

Research Themes for Possible Collaboration

- Fabrication of junctions of foreign materials (semiconductor, metal, insulator, and so on) that are fabricated using direct bonding technologies
- Characterization and device application of such heterogeneous-integration-based junctions and interfaces.

A List of 5 Key Publications

- Naoteru Shigekawa, Tomoya Hara, Tomoki Ogawa, Jianbo Liang, Takefumi Kamioka, Kenji Araki, and Masafumi Yamaguchi, "GaAs/Indium Tin Oxide/Si Bonding Junctions for III-V-on-Si Hybrid Multijunction Cells With Low Series Resistance", IEEE J. Photovolt. **8** (3), pp. 879-886 (2018) (8 pages) (DOI: 10.1109/JPHOTOV.2018.2802203).
- Naoteru Shigekawa, Sae Shimizu, Jianbo Liang, Masato Shingo, Kenji Shiojima, and Manabu Arai, "Transport characteristics of minority electrons across surface-activated-bonding based p-Si/n-4H-SiC heterointerfaces", Jpn. J. Appl. Phys. **57**, 02BE04 (2018) (5 pages) (DOI: 10.7567/JJAP.57.02BE04).
- Jianbo Liang, Katsuya Furuna, Moeko Matsubara, Marwan Dhamrin, Yoshitaka Nishio, and Naoteru Shigekawa, "Aluminum Foil/Si Direct Bonding as Prototypes of Ultra-Thick Metal Contacts in Devices", ECS J. Solid State Sci. Technol., **6** (9) pp. P626-P632 (2017) (7 pages) (DOI: 10.1149/2.0251709jss).
- Jianbo Liang, Satoshi Masuya, Makoto Kasu, and Naoteru Shigekawa, "Realization of direct bonding of single crystal diamond and Si substrates", Appl. Phys. Lett. **110**, 111603 (2017) (4 pages) (DOI: 10.1063/1.4978666).
- J. Liang, S. Nishida, M. Arai, and N. Shigekawa, "Improved electrical properties of n-n and p-n Si/SiC junctions with thermal annealing treatment," J. Appl. Phys. **120**, 034504 (2016) (7 pages) (DOI: 10.1063/1.4959072).