



Dilute Nitride Solar Cells - Technology Developments Towards 50% Efficiency

Citation

Guina, M., Tukiainen, A., Aho, A., & Polojärvi, V. (2017). *Dilute Nitride Solar Cells - Technology Developments Towards 50% Efficiency*. Paper presented at 2017 MRS Spring Meeting & Exhibit, Phoenix, United States.

Year

2017

Version

Other version

Link to publication

[TUTCRIS Portal \(http://www.tut.fi/tutcris\)](http://www.tut.fi/tutcris)

Take down policy

If you believe that this document breaches copyright, please contact cris.tau@tuni.fi, and we will remove access to the work immediately and investigate your claim.

Dilute nitride solar cells: technology developments towards 50% efficiency

Mircea Guina, Antti Tukiainen, Arto Aho, Ville Polojärvi

Optoelectronics Research Centre, Tampere University of Technology, Korkeakoulunkatu 3, FI-33720 Tampere, Finland

Dilute nitride materials, i.e. family of GaInNAsSb/GaAs compounds, offer ideal band-gap and lattice characteristics for the development of tandem lattice-matched solar cells with more than 3 junctions. In terms of material quality and efficiency performance, molecular beam epitaxy (MBE) has recently emerged as the preferred alternative for the development of such multi-junction solar cells. However, despite the proven potential of this material system for demonstrating high-efficiency lattice-matched tandem cells, a certain level of pessimism remains in respect with the potential for large scale deployment of MBE as cost-effective manufacturing approach. While there are clear cost advantages for metal-organic chemical vapour deposition (MOCVD) processes, largely linked to the high growth rates and throughput, there are no fundamental limits that would prevent emergence of MBE as a cost-effective manufacturing technology for solar cells with 4 or more junctions.

From this general perspective, we review a new technology approach for the fabrication of multi-junction solar cells combining the best parts of the MOCVD and MBE techniques to realize high-efficiency tandem solar cells [1]. As an implementation example, triple-junction GaInP/GaAs/GaInNAsSb (1 eV) solar cells exhibiting an efficiency of ~31% for 1-sun illumination are reported.

We also review recent developments concerning the fabrication of 4-junction dilute-nitride solar cells involving MBE-only processes. In particular, we focus on performance characteristics of solar cells incorporating two dilute nitride sub-junctions with absorption edge at 1.2 eV and 0.9 eV. Finally, a development outline towards demonstrating solar cells with efficiency of 50% is discussed.

[1] A. Tukiainen, A. Aho, G. Gori, V. Polojärvi, M. Casale, E. Greco, R. Isoaho, T. Aho, M. Raappana, R. Campesato and M. Guina; High-efficiency GaInP/GaAs/GaInNAs solar cells grown by combined MBE-MOCVD technique; *Progress in PV: Research. and Applications*, 24, 7, p. 914-919 (2016)