Invited-

HAADF STEM Imaging of Dislocation Loops in Irradiated GaAs

Neethling J.H., Janse van Vuuren A. and Olivier E.J.

Centre for HRTEM, Nelson Mandela University, Port Elizabeth, South Africa

GaAs based space solar cells have a higher conversion efficiency and better radiation resistance than Si solar cells [1]. Solar cells used in space are exposed to severe radiation and the lattice defects induced by high-energy electron and proton irradiations cause a decrease in the power output of the solar cells [1]. Radiation damage and the formation and growth of dislocation loops in GaAs have been studied in detail over many years [2-4]. In this paper, atomic resolution images of small dislocation loops in irradiated GaAs are presented. The images was recorded by using a double Cs-corrected TEM. The high resolution images together with earlier conventional TEM results of proton, electron and neutron irradiated and annealed GaAs are used to correct the earlier faulty identification of the nature and habit planes of small dislocation loops on {110} and {111} planes and hydrogen platelets on {111} planes of GaAs [2-3].

Small dislocation loops on {110} and {111} planes in both 1MeV electron and neutron irradiated GaAs became visible after annealing at 500°C. Atomic resolution HAADF STEM analyses of the loops revealed that the small loops on {111} planes consist of an interstitial layer of GaAs atoms with two layers of GaAs atoms in twin orientation. HAADF STEM indicated that the small loops on {110} planes are pure-edge interstitial dislocations consisting of two layers of GaAs atoms. A thorough understanding of the mobility and agglomeration behavior of irradiation induced point defects in GaAs is important for its widespread use in space missions where higher conversion efficiencies and radiation resistance are required.

References

[1] Yamaguchi M, Solar Energy Materials & Solar Cells 2001; 68: 31.
[2] Neethling JH, Snyman HC, J. Appl. Phys. 1986; 60: 941.
[3] Neethling JH, Physics B 1991; 170: 285.
[4] Neethling JH, Proc. 13th Internat. Congress on Electron Microsc, Paris, 1994: 101.