274th MSL Seminar

Date & Time: July 1, 2014 14:00-15:30

Venue: Meeting Room, 1F R3 Building, Suzukake-dai Campus, TIT

Subject: Light Induced Instability Mechanism in amorphous InGaZn Oxide Semiconductors

Lecturer: John Robertson, Professor, Engineering, Cambridge University, UK

Summary: Amorphous InGaZn oxide (IGZO) is of great interest as a higher mobility, large area electronic oxide for thin film transistors in display applications [1]. It has a higher mobility than a-Si:H. However, it suffers from an instability, the negative bias illumination stress instability, whose cause is widely debated. Oxygen vacancies are often given as the cause. However, vacancies are donors and there is already an excess of donors in the system, due to accidental hydrogen donor impurities [2]. Here, a model of the instability is presented, based on the photo-excitation of electrons from oxygen interstitials. The O interstitials are present to compensate hydrogen donors. The O interstitials are found to spontaneously form in O-rich conditions for Fermi energies at the conduction band edge, much more easily than in other oxides like ZnO. The excited electrons give rise to a persistent photoconductivity due to an energy barrier to recombination [3]. The formation energy of the O interstitials varies with their separation from the H donors, which leads to the observed voltage stress dependence on the compensation. The model differs from that of Nahm et al [4] who considered bulk O-O centers [2]. A number of other acceptor defects such as Zn or in vacancies could also be unstable. The model is still incomplete in that the full role of water and hydrogen in these oxides, and their role in annealing is not really understood [2,5].

1. K Nomura, H Ohta, T Kamiya, M Hirano, H Hosono, Nature 432 488 (2004)
2. K Nomura, et al, ECS J Solid State Sci Tech 2 5 (2013)
3. J Robertson, Y Guo, APL 104 162102 (2014)
4. H Nahm et al, Phys Stat Solidi B 249 1277 (2012)
5. Y Hanyu et al, APL 103 202114 (2013)