【T-08】

The Er^{3+} photoluminescence properties in Er-doped nc-Si/SiO_2 superlattices formed by ion sputtering

Ji-Hong Jhe*, Moon-Seung Yang* and Jung H. Shin*, Kyung Joong Kim** and Dae Won Moon**

*Dept. of Physics, Korea Advanced Institute of Science and Technology(KAIST)

**Nano Surface Group, Korea Research Institute of Standard and Science(KRISS)

Er-doping of Si has been studied intensely in hopes of developing Si-based optoelectonic devices. Despite the large advances, the Er^{3+} luminescence efficiency achieved is still rather low to realize the devices operating at room temperature. Recently, silicon rich silicon oxide(SRSO), which consisted of Si nanocrystals(nc-Si) embedded in SiO_2 matrix[1-3], appears as one of promising candidate for host material and by using SRSO, it is possible to obtain both the high excitation efficiency of Si and the high luminescence efficiency of SiO_2. Unfortunately, the size and density of nc-Si and the location of Er atoms, which are key parameters for obtaining efficient Er^{3+} luminescence, are difficult to control in SRSO. However, such parameters can be easily controlled in SiO_x(x<2)/ SiO_2 superlattice.

In this work, the effects of Si nanocluster on the Er^{3+} photoluminescence properties of Er-doped nc-Si/SiO_2 superlattices[4-6] were investigated. The Er-doped SiO_x/SiO_2 superlattice films were deposited by UHV-ion beam sputtering method and were subsequently annealed at 950 or 1100 C. After annealing, Er atoms were well confined in SiO_2 layers whose thickness was fixed at 8 nm. The formation of nc-Si was observed in the films annealed at 1100 C. The size of nc-Si was controlled through the variation of oxygen content(x) and determined by high-resolution transmission electron microscopy(HRTEM). We observed the intense Er^{3+} photoluminescence from Er-doped nc-Si/SiO_2 superlattices and more detailed discussion about the Er^{3+} photoluminescence properties will be presented.

[References]

1. A. J. kenyon, P. F. Trwoga, M. Federighi, and C. W. Pitt, J. Phys. : Condense. Matter 6, L319 (1994)

2. M. Fujii, M. Yoshida, Y. Kanazawa, S. Hayashi, and K. yamamoto, Appl. Phys. Lett. 71, 1198 (1997).
3. J. H. Shin, M. J. Kim, S. Y. Seo, and C. C. Lee Appl. Phys. Lett. 72, 1092(1998).
4. J. H. Shin, W. H. Lee, and H. S. Han, Appl. Phys. Lett. 74, 1573(1999).
5. J. H. Shin, J. H. Jhe, S. Y. Seo, Y. H. Ha, D. W. Moon, Appl. Phys. Lett. 76, 3567(2000).
6. Y. H. Ha, S. H. Kim, D. W. Moon, J. H. Jhe, and J. H. Shin, Appl. Phys. Lett. 79, 287(2001).