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Ge Nanocluster Enhanced Er Photoluminescence[1] JULIAN GUZMAN, DARYL C. CHRZAN, EUGENE E. HALLER, University of California, Berkeley and Lawrence Berkeley National Laboratory — We investigated the enhancement of the Er^{3+} photoluminescence (PL) at 1540 nm by the incorporation of Ge nanoclusters into Er-doped silica using ion beams. We found that the Er^{3+} PL enhancement is due to the presence of Ge and not to the radiation damage from the ion-implantation process. We determined that the Er^{3+} PL depends on the Ge content, postgrowth annealing, and crystallinity of the Ge nanoclusters. Furthermore, we observed that the Er^{3+} PL signal is maximized after annealing at 685 $^{\circ}$C for 1 h. This is the temperature at which Ge nanoclusters begin to crystallize. Transmission electron microscopy studies were conducted to determine the size distribution of the Ge nanoclusters. Moreover, extended X-ray absorption fine structure measurements performed at the Ge-K and Er-L_{III} edges revealed that there is negligible Ge-Er bonding. This suggests that Er is either fully oxidized or that it is not located in the Ge nanoclusters. Therefore, we believe that the energy transfer process from the Ge nanoclusters to the Er ions occurs through a non-optical resonant dipole transfer (Förster Process[2] similar to what has been proposed for the Si nanocrystal case.[3]

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[2]T. Förster, *Discuss. Faraday Soc.* **27**, 7 (1959).
[3]M. Fujii, M. Yoshida, S. Hayashi, and K. Yamamoto, *J. Appl. Phys.* **84**, 4525 (1998).

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