Highly luminescent a-SiOx<Er>/SiO2/Si multilayer structure

Rossano Lang, David S. L. Figueira, Felipe Vallini, Newton C. Frateschi

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We have fabricated highly-luminescent samples with erbium-doped amorphous silicon sub-oxide (a-SiOx<Er>) layers on SiO2/Si substrates. The layers are designed to provide a resonance with large modal overlap with the active material and with low quality factor (Q-factor) at 1540 nm. Also, the structure has higher Q-factor resonances in the wavelength range between 600 - 1200 nm. Within this range, strong light emission from a-SiOx defect-related radiative centers and emission from the Er3+ optical transition 4I11/2 - 4I15/2 (980 nm) are observed. A two-fold improvement in photoluminescence (PL) intensity is achieved in the wavelength range between 800 - 1000 nm. The PL intensity in the wavelength range between 1400 - 1700 nm (region of Er3+ 4I13/2 - 4I15/2 transition) is increased four times. This later higher intensity enhancement is apparently caused by optical pumping at 980 nm, higher Q-factor, with subsequent emission from the 4I13/2 level in the low Q resonance at 1540 nm. Further five times emission enhancement is obtained after optimized temperature annealing. The temperature-induced quenching in the PL intensity indicates distinct deactivation energies related to different types of Er centers which are more or less coupled to defects depending on the thermal treatment temperature.

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