Silicon microdisk structures with rare-earth doped amorphous silicon

David Figueira and Newton C. Frateschi
UNICAMP–Instituto de Física Gleb Wataghin, Brazil

The development of silicon-based active optical devices has been a target of constant interest in recent years due the possibility of integration with CMOS technology. Silicon doping with rare-earth elements is an alternative for efficient light emission in the C-band. Particularly, erbium doped hydrogenated amorphous silicon (a-Si:H<Er>) is of interest given the high Er^{3+} doping concentration that can be achieved and the efficient defect related Auger excitation process. Microdisks with whispering gallery modes offer a great advantage for stimulated emission generation in small volumes where long photon lifetime is achieved with simple processing steps. Also, the emission along the substrate plane is suitable for photonic integration. Moreover, with the use of non-cylindrically symmetric stadium structures, one may achieve higher directional and spectral control over the emission, thereby expanding the integration possibilities.

In this work we present our results on microdisks and stadium resonators based on a-Si:H<Er> and(a-SiO_x:H<Er> layers sandwiched in air and SiO_2, obtained by wet oxidation of Si substrates. Rutherford backscattering spectroscopy (RBS) results show erbium concentrations of $1.0x10^{20}$ atoms/cm^3 that is responsible for large photoluminescence emission at 1540 nm, shown Fig. 1. Also, we will describe the photoluminescence dependence on annealing temperature and oxygen content. Finally, we will be presenting our preliminary results on resonant structures focused on directional and spectral properties of the emission.

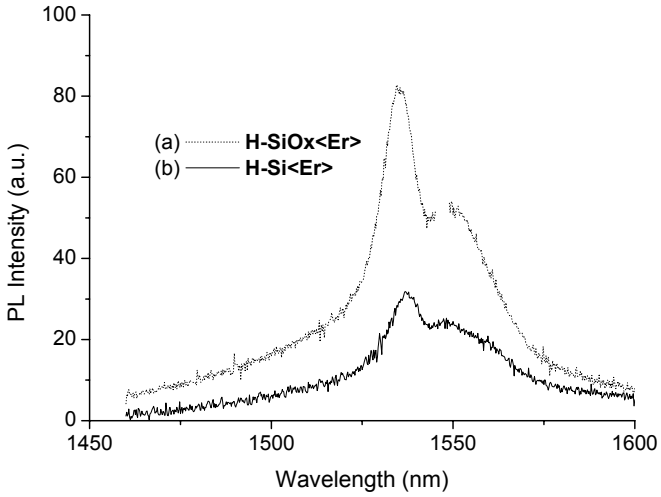

FIG. 1. PL emission from amorphous silicon co-deposited with erbium: (a) SiO_2 target; (b) Si target.