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Erbium Doped Materials for a Si-based Microphotonics

F. Priolo[1,2,a], G. Franzò[2,b], F. Iacona[3,c], A. Irrera[2,d], R. Lo Savio[1,2,e], M. Miritello[1,2,f], and E. Pecora[1,2,g]

[1]Dipartimento di Fisica e Astronomia, Università di Catania, Via S. Sofia 64, 95123 Catania, Italy

[2]MATIS CNR-INFM, Via S. Sofia 64, 95123 Catania, Italy

[3]CNR-IMM, Sezione di Catania, Stradale Primosole 50, 95121 Catania, Italy

[a]priolo@ct.infn.it, [b]franzo@ct.infn.it, [c]fabio.iacona@imm.cnr.it, [d]alessia.irrera@ct.infn.it, [e]roberto.losavio@ct.infn.it, [f]maria.miritello@ct.infn.it, [g]emanuele.pecora@ct.infn.it

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Abstract. We have investigated the role of the Si excess on the photoluminescence properties of Er doped substoichiometric SiO_x layers. We demonstrate that the Si excess has two competing roles: when agglomerated to form Si nanoclusters (Si-nc) it enhances the Er excitation efficiency but it also introduces new non-radiative decay channels. When Er is excited through an energy transfer from Si-nc, the beneficial effect on the enhanced excitation efficiency prevails and the Er emission increases with increasing Si content. Nevertheless the maximum excited Er fraction is only of the order of percent. In order to increase the concentration of excited Er ions, a different approach based on Er silicate thin film has been explored. Under proper annealing conditions, an efficient luminescence at 1535 nm is found and all of the Er ions in the material is optically active. The possibility to efficiently excite Er ions also through electron–hole mediated processes is demonstrated in nanometer-scale Er–Si–O/Si multilayers. These data are presented and discussed.