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Optical Properties of Si-Integrated Group-IV Light Emitting Diodes JAMES GALLAGHER, CHARUTHA SENARATNE, CHI XU, JOHN KOUVETAKIS, JOSE MENENDEZ, Arizona State Univ — Light emitting diodes (LEDs) using GeSn and GeSiSn alloys are incorporated on Si(100) substrates using custom deposition chemistries and novel buffer layer strategies. The emission properties of these devices are studied by room temperature electroluminescence (EL) as a function of alloy composition and device architecture. The GeSn devices investigated span the range from indirect to direct gap semiconductors (0-12% Sn). In the case of ternary GeSiSn diodes, two composition ranges are studied: one with fixed Si (2-3%) while the Sn is varied (3-11%), and the other with fixed Sn (9-11%) and varying Si (3-10%). The results from the former set show a transition towards direct gap materials and the latter demonstrate a blueshift of the direct gap signal to higher energies within the mid IR. The basic device design begins with a n-Ge contact grown on a Si substrate followed with the i-GeSn active layer and the p-GeSn top electrode. Electron microscopy of the samples reveals a defective n/i and a defect-free i/p interface. The n/i defects can be eliminated by substituting a lattice matched n-GeSn material for the n-Ge layer producing homo-structure designs that significantly improve the emission efficiency of the LEDs.

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