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Photoluminescence measurements of high Sn-content $Ge_{1-y}Sn_y$ and $Ge_{1-x-y}Si_xSn_y$ grown on Ge-buffered Si YUNG KEE YEO, THOMAS R. HARRIS[1], Department of Engineering Physics, Air Force Institute of Technology, Wright-Patterson AFB, OH 45433, USA, BUGUO WANG, Department of Physics, Wright State University, Dayton, OH 45435, USA, MEE-YI RYU, Department of Physics, Kangwon National University, Chuncheon 200-701, Korea, JOHN KOUVETAKIS, Department of Chemistry and Biochemistry, Arizona State University, Tempe, Arizona 85287, USA — The optical properties of newly developed, high Sn-content $Ge_{1-y}Sn_y$ and $Ge_{1-x-y}Si_xSn_y$ thin films grown on Ge-buffered Si have been characterized using temperature-dependent and laser power-dependent photoluminescence (PL) measurements. The results show two distinct PL peaks related to both the direct (Γ) and indirect (L) bandgap transitions. Furthermore, the measured separation energy between the direct and indirect bandgap related PL peaks for $Ge_{0.948}Sn_{0.052}$ sample is only about 30 meV compared to the value of 140 meV for bulk Ge. This study shows a very encouraging result toward producing Ge- and Si-based direct bandgap semiconductors, whose predicted indirect-to-direct bandgap crossover could be near 6% Sn. Clear competition between the two transitions is also observed as a function of temperature and laser power. Overall, this work represents an extensive PL characterization of $Ge_{1-y}Sn_y$ and $Ge_{1-x-y}Si_xSn_y$ materials over a wide compositional range and should be useful for the development of next-generation optoelectronic devices.

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