Electrically injected GeSn laser on Si substrate operating up to 130 K.

S. Acharya,[1] **S. Ojo,**[1] **Y.Zhou**[2], **S. Amoah**[2], **W.Du**[2], **B. Li**[3] **,S. Yu**[1,2]

[1] *Material Science and Engineering, University of Arkansas, Fayetteville, Arkansas 72701 USA*

[2]*Department of Electrical Engineering, University of Arkansas, Fayetteville, Arkansas 72701 USA*

[3]*Arktonics, LLC, 1339 South Pinnacle Drive, Fayetteville, AR, USA 72701*

Germanium-tin (GeSn) semiconductors have gained significant attention over the last years as a group IV material for the development of novel Si-based optoelectronic devices. Specifically, direct band gap GeSn alloys with Sn fractions above 8% are of interest as light emitting sources in the near- and mid-infrared spectral range. In addition, GeSn epitaxy is monolithic on Si and also fully compatible with the complementary metal-oxide semiconductor (CMOS) technology, making it a promising candidate for the integrated light source on the Si platform, with advantages such as cost-effectiveness, reliability, and compactness [2]. Recently, GeSn lasers on Si substrate were demonstrated both under optical pumping and electrical injection. In this work, we report an electrically injected GeSn/SiGeSn laser grown on Si substrate operating up to 130 K. Our study is mainly focused on the cap layer effect on the optical loss for lasing devices. The GeSn/SiGeSn heterostructure was grown using chemical vapor deposition (CVD) technique. The laser devices were fabricated in ridge waveguide structures with 80 µm, 100 µm and 120 µm wide ridges. The lasing performance was investigated under pulsed conditions. The electroluminescence signal was collected through a monochromator and liquid-nitrogen-cooled InSb detector (response range 1–5.5 µm). The L-I characteristics of devices with different cavity lengths were studied at different temperatures. Our results suggest pathways for enhancing the lasing performance of electrically injected GeSn laser diodes.

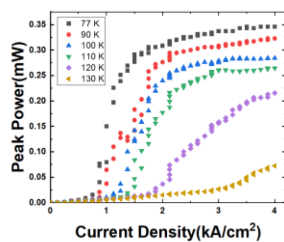
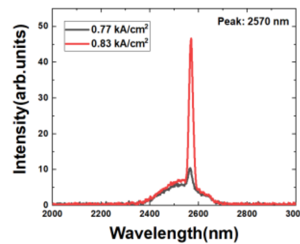


Figure1 Temperature dependent L-I curve.



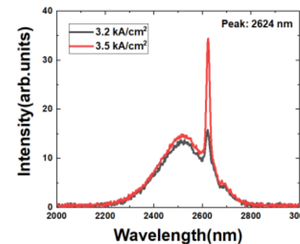


Figure 2(a, b) : Lasing spectra at and above threshold for 77K and 130 K temperature respectively

[1] Yiyin Zhou, Yuanhao Miao, Solomon Ojo, Huong Tran, Grey Abernathy, Joshua M. Grant, Sylvester Amoah, Gregory Salamo, Wei Du, Jifeng Liu, Joe Margetis, John Tolle, Yong-hang Zhang, Greg Sun, Richard A. Soref, Baohua Li, and Shui-Qing Yu, "Electrically injected GeSn lasers on Si operating up to 100 K," Optica 7, 924-928 (2020)

[2] Solomon Ojo, Yiyin Zhou, Sudip Acharya, Nicholas Saunders, Sylvester Amoah, Yue-Tong Jheng, Huong Tran, Wei Du, Guo-En Chang, Baohua Li, Shui-Qing Yu, "Silicon-based electrically injected GeSn lasers," Proc. SPIE 11995, Physics and Simulation of Optoelectronic Devices XXX, 119950B (4 March 2022); https://doi.org/10.1117/12.2615476