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Correlation Between Optical, Morphological and Compositional Properties of GeSn Epitaxial Layers Irradiated by Nd:YAG Laser Radiation

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Si-based materials have been the driving force behind the rapid development of revolutionary electronic technology and have dominated the market for the past 40 years. As a parallel effort to advance the reach of group IV technology to mid-infrared range, researchers have strived for years to create group IV-based optical devices that can exploit the benefits of silicon while also being fully compatible with Si electronics.

The all group of IV alloy of germanium-tin (GeSn) based material has shown promising characteristics extending the detection range to long wavelength range, however due to limited Sn atoms solubility, only 4% Sn in alloys with Ge are currently available. Moreover, GeSn is predicted to exhibit an indirect to direct band gap transition at alloy Sn composition of 6.5% [1]. Therefore, we applied pulsed laser radiation to $Ge_{0.96}Sn_{0.04}$ layers epitaxially grown on Si substrates by MBE (molecular beam epitaxy) to redistribute Sn atomic content according to thermogradient effect [2] with the aim to increase Sn content at the surface. We used nanosecond laser radiation (1064 nm wavelength, 6 ns pulse duration) with different intensities in the range I=107.8-463.5 MW/cm^2 to modify GeSn layer. The X-ray photoelectron spectroscopy, Raman and UV reflection spectra confirmed Sn atomic content increase at the surface by order of magnitude. SEM (Fig.1.) and AFM imaging provided evident microstructure changes, while carrier lifetime changes determined by differential transmittivity were not observed, indicating that laser irradiation does not reduce material electronic quality.

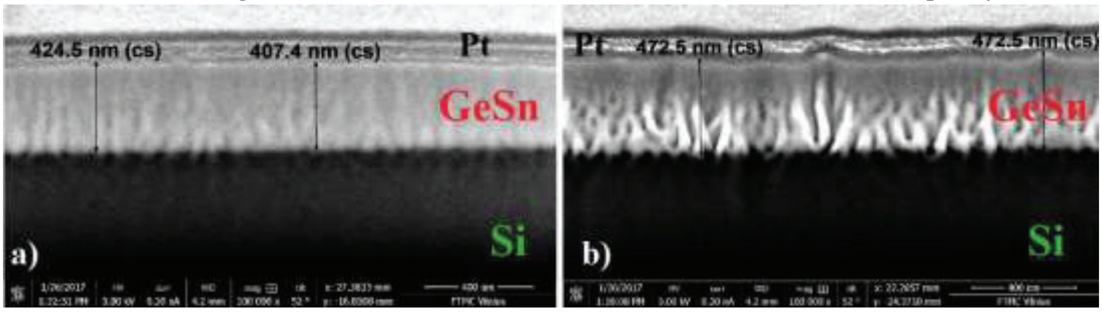

Fig.1 SEM images of FIB cross-section of non-irradiated Pt/Ge0.96Sn0.04/Si structure (a) and irradiated by Nd:YAG laser radiation at I=136.7 MW/cm^2 (b). Pt layer was deposited on the GeSn surface as protective layer for cross-sectioning

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[1] S. Gupta, B. Magyari-Köpe, Y. Nishi, and K.C. Saraswat, J. Appl. Phys. 113, (2013).
[2] A. Medvid, Defect and Diffusion Forum, 2002, vol. 210–212, pp. 89–102.

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