**Direct band gap emission from hexagonal Ge and SiGe alloys**

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Silicon crystallized in the usual cubic (diamond) lattice structure has dominated the electronics industry for more than half a century. However, cubic silicon (Si), germanium (Ge) and SiGe-alloys are all indirect band gap semiconductors that cannot emit light efficiently. Accordingly, achieving efficient light emission from group-IV materials has been a holy grail in silicon technology for decades and, despite tremendous efforts, it has remained elusive. Recently, Ge- rich alloys, with a hexagonal structure have been theoretically predicted to exhibit a direct band gap nature (Joannopoulos *et al*. 1973). Density functional theory (DFT) calculations predict a 0.3 eV bandgap for Hex- Ge, which can be tuned up to 0.9 eV by alloying with Si (Rödl *et al.* 2019). Yet, the fundamental bottleneck is that Ge and SiGe alloys crystallize naturally in the cubic structure which is optically inactive due to its indirect bandgap nature.

Here, we explain the realization of Hex- SiGe in big volumes by utilizing wurtzite GaAs nanowire cores as a template to transfer the crystal structure to the SiGe shells in a core-shell geometry. We also demonstrate efficient bandgap emission from Hex-Ge and SiGe alloys. We measure a sub nanosecond radiative recombination life time and we show by alloying Ge with Si; we can tune the band gap emission in the wavelength range of 1.8 µm and 3.5 µm. Our experimental results are in excellent agreement with the DFT calculations for the band structures of Hex-Ge and -SiGe alloys (Fadaly *et al.* 2019).These results reveal the strong potential of this new material system for SiGe based light emitting devices. It also paves the way towards uniting the electronic and optoelectronic functionalities on a single chip, opening new frontiers for new device design concepts.

**References**

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