

Epitaxial Si-Ge-Sn heterostructures for optics, electronics and thermoelectric applications

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The experimental demonstration of Sn-based optically pumped lasers grown on Silicon exponentially increased the research interest in group-IV semiconductors. As the only direct bandgap alloy in the Si-group, GeSn binaries may offer a unique solution for the monolithic integration of photonics with the current CMOS technology.

The low solid solubility of Sn and its large difference in lattice constants regarding Ge and Si make the epitaxy a challenge. Conditions far away from thermodynamic equilibrium, that is, high growth rates and low growth temperatures, have resulted in films with high crystalline quality making CVD the technique of choice. The present studies show that the properties of Sn-based materials can be tailored via the Sn content, strain engineering, or further alloying with Si, to design structures or quantum heterostructures that address specific physical effects or applications.

The talk presents the growth methodology, the electronic band-structure peculiarities, and different experimental device results from the point of view of applications. The emphasis will be on lasing effect, lattice heat transport, as well as on the performance of GeSn NW FET devices from room temperature to cryogenic CMOS applications.