# Recent progress in Ni-based GeSn metallization

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GeSn alloys can be used as high hole mobility channels in p-type Metal Oxide Semiconductor Field Effect Transistors (pMOSFETs) [1] or Tunnel FETs (pTFETs) [2], as source and drain stressors in Ge pMOSFETs [3] or in p-i-n photodetectors [4], Light Emitting Diodes (LEDs) [5] optically [6] and electrically [7] pumped lasers. Really high Sn content (15% - 17%) metastable layers can be grown on Ge Strain Relaxed Buffers for optical and electrical purposes [8], this even if the lattice mismatch between Sn and Ge is large (14%) and the solubility of Sn in Ge low (< 1%). Electron mobility is otherwise expected to be high in large Sn content, direct bandgap Ge1-xSnx alloys. Indeed, the effective mass of electrons is smaller at the Γ than at the L point of the conduction band of such alloys. This is different with pure Ge, where the mobility is reduced due to the lowest L band [9].

Technological modules have thus to be developed on GeSn. In particular, an electrical contact technology fully compatible with a Si-Fab line has to be optimized to benefit from an efficient electrical supply. Various fields such as surface preparation, solid-state reaction and metallization, electrical properties and integration schemes have to be explored, then.

After an overview of the existing literature, we will focus here on CEA-Leti’s recent results on Ni-based GeSn metallization. In particular, we will discuss the solid-state reaction between a Ni thin film and GeSn layers, the subsequent formation of Ni / GeSn intermetallics and the impact of Sn content [10, 11]. The thermal stability of NiGe(Sn) monostanogermanide being low, we will discuss the technological levers that can be actioned to enhance its stability such as the addition of alloying elements [12,13] and the use of pre-amorphization by implantation prior to metallization [14].

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