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New GeSi doping strategies based on $P(SiH_3)_3$ for next-generation CMOS technologies[1] ANDREW CHIZMESHYA, CHI XU, Dept of Chem-Biochem, Arizona State University, JAMES GALLAGHER, Dept of Physics, Arizona State University, PATRICK SIMS, Dept of Chem-Biochem, Arizona State University, DAVID SMITH, JOSE MENENDEZ, Dept of Physics, Arizona State University, JOHN KOUVETAKIS, Dept of Chem-Biochem, Arizona State University — GeSi *n*-type films are synthesized using the specially designed hydrides $P(SiH_3)_3$, Ge_3H_8 and Ge_4H_{10} for applications in next-generation CMOS technologies. The films are grown on Ge-buffered Si(100) at 340 °C using two methods. The first employs a gas-source molecular epitaxy approach and Ge_4H_{10} to yield films with P doping densities up to 3.5 x $10^{19}/cm^3$. The amount of Si incorporated equals or exceeds the 3:1 ratio in the $P(SiH_3)_3$ compound. The second approach applies an ultra-high vacuum chemical vapor deposition technique and Ge_3H_8 in place of Ge_4H_{10} to achieve higher carrier concentrations up to 6 x $10^{19}/cm^3$. The Si:P ratio in this case is well below the 3:1 value expected from the precursor. The electron mobilities for both types of samples are significantly higher than state-of-the-art prototypes, probably due to superior microstructure and dearth of inactive donors. The relative stability of Si-P and Ge-P bonds in a Ge matrix is studied with *ab initio* methods. $P-I-N$diodes fabricated using $P(SiH_3)_3$ show excellent *I-V* characteristics that are virtually undistinguishable from similar diodes doped with the $P(GeH_3)_3$ precursor. These results confirm $P(SiH_3)_3$ as a viable doping source that is practical from a process standpoint and therefore attractive for industrial scale-up.

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