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SiGe Nanomembranes: Defect-Free Single-Crystalline Substrates for Growth of Strained Si/SiGe Heterostructures[1] DEBORAH M. PASKIEWICZ, BOY TANTO, DONALD E. SAVAGE, PAUL G. EVANS, MARK A. ERIKSSON, MAX G. LAGALLY, University of Wisconsin-Madision — Silicon-Germanium semiconductor alloys play a pivotal role in the strain engineering of heterostructures for microelectronic devices; however, high quality, single crystalline, defect free films with more than minimal Ge concentration do not exist. The lattice mismatch between Si and bulk SiGe results in biaxial tensile strain in thin Si films and leads to electronic band offsets that allow for the confinement of electrons in the strained Si layer, i.e., a two-dimensional electron gas. Many of the current techniques used to create relaxed SiGe rely on plastic relaxation of the alloy, which impose strain variations and inject crystalline defects into all epitaxial layers grown on top. These defects can significantly degrade the performance of any device in the active layer. We demonstrate the fabrication of SiGe nanomembranes (NM): fully elastically relaxed, smooth, single-crystalline sheets of SiGe alloy. These SiGe NMs can be transferred to new handling substrates, bonded, and used as templates for growth of new defect-free materials. We compare the material quality of strained Si/SiGe heterostructures grown on SiGe NMs with those created on SiGe substrates relaxed via dislocations.

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