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Strain and Shape-Driven Self-Organization of Atomically Abrupt Junctions on Patterned Ge (001) Surfaces BORIS LUKANOV, KEVIN GARRITY, FRED WALKER, SOHRAB ISMAIL-BEIGI, ERIC ALTMAN, Yale University — We employ STM, electron diffraction, and other experimental techniques, complemented by density functional theory, in order to explore the interaction of alkaline-earth metals with the Si and Ge (001) surfaces on the atomic scale. Our results reveal a complex series of phase transitions as the alkaline-earth coverage is varied. Each phase transition is accompanied by significant changes in the surface morphology that can only be explained by mass transfer induced by the formation of alloy surfaces. Through comparison of bias-dependent atomic-resolution STM images with first-principle calculations, we develop atomic structural models of the surface alloy phases. Incorporation of the larger alkaline earth atoms into the Ge surface creates anisotropic strain that is ultimately relieved by the formation of remarkably well-ordered arrays of islands and trenches. With applications in mind, we investigate deposition onto a Ge substrate lithographically patterned with shapes, designed to direct the self-organization of the alkaline-earth induced surface structures. Sr deposition onto a Ge substrate patterned with cross-shaped nano-templates results in phase segregation within the template boundaries and the formation of atomically abrupt junctions between the different surface alloys.

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