512b Formation of Epitaxial Ge Nanorings on Si by Self-Assembled Sio_2 Particles and Touchdown of Ge through a Thin Layer of Sio_2

Qiming Li and Sang M. Han

We demonstrate that hexagonally packed single-crystalline Ge rings can be grown around the contact region between self-assembled SiO_2 spheres and 1.2-nm-thick chemical SiO_2 on Si. When the oxide-covered Si substrate is pulled from a colloidal suspension of SiO_2 spheres, the SiO_2 spheres self-assemble into a hexagonally packed monolayer on the substrate. These SiO_2 spheres provide a surface diffusion path to guide the Ge adspecies to reach the substrate. We have previously determined that the Ge adspecies readily desorb from the bulk SiO_2 surface with a desorption activation energy of 42±3 kJ/mol. This low desorption activation energy gives rise to a low surface diffusion barrier, which in turn leads to a high diffusion length on the order of several micrometers, exceeding the dimension of the SiO_2 spheres. With a flux of Ge impinging at 45º from the surface normal, the Ge beam cannot directly impinge on the underlying substrate through the openings between SiO_2 spheres. The Ge adspecies diffuse around the SiO_2 spheres and "touchdown"[Li et al., APL, **85**(11), 1928 (2004)] through the chemical SiO_2, forming epitaxial ring structures. The touchdown process anchors nanoscale Ge seed pads to the underlying Si substrate. The ring formation uniquely takes advantage of the SiO_2 sphere self-assembly; the weak interaction between Ge adspecies and SiO_2; and the touchdown where Ge densely nucleate on Si surface through the 1.2-nm-thick chemical oxide.