Structural and magnetic properties of Ni nanofilms on Ge(001) by molecular beam epitaxy

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Ni films of 20 nm nominal thickness were grown on Ge(001) substrates by molecular beam epitaxy at several different temperatures from room temperature up to 400 °C. Their structure and their magnetic properties were determined with in-situ and ex-situ techniques. XRD and XPS reveal the nucleation of Ni-Ge compounds (NiGe, Ni_2Ge, Ni_5Ge_2) as well as a departure from the *fcc* Ni structure exhibited by the films at and beyond a temperature of 100 °C. The Ni 2p binding energy increases, while the Ge 2p binding energy is not strongly affected by the metal deposition. Ni diffuses further into the germanium with higher substrate temperature, forming increasingly Ni-rich Ni-Ge compounds diluted into the Ge matrix (such that LEED patterns of Germanium are still visible after growth on 300 and 400 °C substrates). MOKE measurements show the magnetic character of hexagonal Ni_5Ge_2 (which is determined here for the first time to be a room-temperature ferromagnetic phase).