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Optimal doping control of magnetic semiconductors CHANGGAN ZENG, ZHENYU ZHANG, KLAUS VAN BENTHEM, MATTHEW CHISHOLM, HANNO WEITERING — Dilute magnetic semiconductors (DMS) with high ferromagnetic ordering temperatures (T_C)have vast potential for advancing spin-based electronics or "spintronics". To date, achieving high-T_C DMS typically required doping levels of order 5%. Such high doping levels inevitably compromise the structural homogeneity and carrier mobility of the DMS. Here, we establish "*subsurfactant epitaxy*" as a novel kinetic pathway for synthesizing Mn-doped germanium with T_C much higher than room temperature, at dramatically reduced doping levels. This is accomplished by optimal control of the diffusion kinetics of the dopant atoms near the growth front in two separate deposition steps. The first involves a submonolayer dose of Mn on Ge(100) at low temperature, which populates subsurface interstitial sites with Mn while suppressing lateral Mn diffusion and clustering. The second step involves epitaxial growth of Ge at elevated temperature, taking advantage of the strong floating ability of the interstitial Mn dopants towards the newly defined subsurface sites at the growth front. Most remarkably, the Mn dopants trapped inside the film are uniformly distributed at substitutional sites, and the resulting film exhibits ferromagnetism above 400 K at the nominal doping level of only 0.2%.

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