Synthesis of Germanium Nanowires in Supercritical Fluid Reactors

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Relatively high carrier concentration (2.4 X 10^{13} cm^{-3}) and mobility (3900 $cm^2/V{\cdot}s$ for electron and 1900 $cm^2/V{\cdot}s$ for hole) of germanium make germanium nanowires (Ge NWs) an attractive candidate as a charge transport channel in various devices. Ge NWs can be synthesized by injecting Ge atoms in gold seed particles at a temperature above the eutectic point of Ge and Au (361 ℃). A large-scale synthesis of Ge NWs is possible by using dense fluid as a reaction media. Here, we used a supercritical fluid reactor, and successfully synthesized Ge NWs, with diameter ranging from 15 nm to 100 nm and length of several μm. In order to attain supercritical fluid, hexane was heated and pressurized above its critical point. The optimum reaction temperature ranged from 425 ℃ to 450 ℃, while the pressure did not cause changes in product if it is above the critical point. Below 400 ℃, amorphous Ge particles were synthesized. Depending on reaction conditions, Ge NWs exhibited widely different morphologies. In this research, we discuss the effect of temperature, pressure, concentration, Au:Ge ratio and flow rate on the nanowires morphology.