Formation and characterization of multilayer GeSi nanowires on miscut Si (001) substrates

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Abstract: Semiconductor nanowires have attracted enormous attention as building blocks for nanoscale electronics, photonics, energy conversion and storage due to their unique electronic, optical and phonon properties [1,2] . Particularly, Si-based nanowires were broadly studied due to their compatibility with the sophisticated Si technology. The nanowires can be fabricated by top-down and bottom-up methods. However, the obtained nanowires so far were generally aligned out-of plane. It was still a big challenge to apply those nanowires in electronic devices and the subsequent integration.[2] In this report, a feasible routine to obtain GeSi nanowires on miscut Si (001) substrates by strain-induced self-assembly processes was described. Laterally arranged GeSi nanowires could be readily formed during heteroepitaxy of Ge on miscut Si (001) substrates with 8^{o} off toward <110>, which were oriented along the miscut direction.[3] Such self-assembled GeSi nanowires were affected by the miscut angle and the growth conditions. By multilayer growth of GeSi nanowires separated with Si spacers, three-dimensionally self-assembled GeSi nanowires were first obtained on the similar miscut Si (001) substrates. In addition, Raman spectra and photoluminescence spectra were obtained from the multilayer GeSi nanowires. These self-assembled GeSi nanowires can be readily embedded in Si matrix and compatible with the sophisticated Si technology. This means that the characterization and the device fabrication of these nanowires can be easily done using sophisticated Si technology. Therefore, these self-assembled GeSi nanowires could facilitate the exploration of the unique properties and the novel device applications of nanowires.

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