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Preparation of Crystalline $Si_{1-x}Ge_x$ Thin Films at Low Substrate Temperature

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Polycrystalline silicon germanium (poly-$Si_{1-x}Ge_x$) thin films have received much attention due to their wide applications for a semiconductor in thin film transistors (TFTs), solar cells, peripheral circuits of liquid-crystal displays, and electrodes in Si-integrated circuits. Conventionally, poly-$Si_{1-x}Ge_x$ thin films were prepared by pulsed laser deposition (PLD), molecular beam epitaxy (MBE) or plasma-enhanced chemical vapor deposition (PECVD) methods.[1-3]. However, in order to realize high crystallinity of $Si_{1-x}Ge_x$thin films, these methods require not only thermal treatments of high temperatures but also long time for the processing.

In our experiments, we have used an intense, pulsed ion-beam to irradiate a solid (sintered) SiGe target under vacuum ($\sim 2\times10^{-4}$ Torr) conditions. Ablated plasma of high density ($\sim 10^{18}$ cm^{-3}) is possible to prepare poly- $Si_{1-x}Ge_x$ thin films on both substrates of crystalline silicon and quartz glass at room temperature, i.e. without the substrate heating and post annealing. The properties of deposited films in terms of crystallinity, deposition rate and surface morphology are characterized by X-ray diffraction (XRD), Raman spectroscopy and scanning electron microscopy (SEM).

[References]

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