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Investigation of as-grown and annealed characteristics of a SiGe/Si heterostructure by structural and compositional analyses

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The as-grown and annealed characteristics of B-doped SiGe layers grown on (001)Si by solid source MBE were investigated with respect to growth and post-growth rapid thermal annealing(RTA) temperatures. The growth temperatures ranged from 350 to 765°C and the RTA temperatures were 850 and 950°C. The SiGe films were characterized by a number of structural and compositional analysis techniques: double crystal x-ray diffractometry, He⁺ ion channeling, electron microscopy, and secondary ion mass spectrometry(SIMS).

The effect of strain relaxation in SiGe films was studied on the activation and the diffusion of B across the heterointerface of SiGe and Si. The SIMS profiles of B and Ge in the as-grown samples were almost identical for the growth temperature range of 350 to 680°C. The extent of strain relaxation due to RTA depended on the crystalline quality of as-grown SiGe films. The diffusion of B during RTA was shown to be faster in the films grown at higher temperature or with poor crystalline quality. However, the diffusion of B showed only a weak dependence on the growth temperature and the extent of strain relaxation under the experimental conditions of the present study. The diffusion of Ge across the heterointerface during RTA was negligible compared to the diffusion of B. The results of the present study provide experimental information on the stability of the SiGe/Si heterointerface as a function of growth or RTA temperature.