GaP/Si Antiphase domains annihilation at the early stages of growth.

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The pseudomorphic growth of GaP on silicon could be used as an efficient platform allowing subsequent integration of defect free III-V based heterostructures and devices[1-3]. In spite of the quasi-lattice matching between GaP and Si, crystalline defects, such as anti-phase domains (APD) and micro-twins (MT) can be generated at the GaP/Si interface and should be avoided for stable performance of optoelectronic devices. Their generation and annihilation is studied in this work. Samples of GaP are grown by molecular beam epitaxy on vicinal Si (001) substrate and are analyzed using high transmission electron and scanning tunneling microscopies.

We first study the influence of the starting silicon surface on the abruptness of the GaP/Si interface and on defects generation. We show the importance of the chemical preparation of the silicon wafer on the quality of a silicon homoepitaxial buffer layer or subsequent III-V overgrowth. With adequate bistepped Si buffer layer and overgrowth conditions, an abrupt GaP/Si interface is obtained, but APDs are not totally eliminated at the very beginning of the growth. It is then shown that the V/III ratio during the III-V regrowth has a drastic influence on APDs annihilation. As a main result, it is shown that most of the APDs can be annihilated within the first 10 nanometers, and that a high quality single domain GaP on Si is achieved below critical thickness.

Mechanisms involved in the formation-annihilation of these defects still need to be clarified.

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