

III-V/Si epitaxial growth and antiphase domains: a matter of symmetry

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Group III-V/group IV epitaxy has recently attracted much interest for applications especially in integrated photonics, or solar energy harvesting devices. For years, the pioneering works of H. Kroemer [1] that successfully identified the key issues, were taken as a reference for the understanding of III-V/Si heteroepitaxy, but recent experimental observations evidenced some inconsistencies with the previous description [2]. In this contribution, we clarify and discuss the driving forces for 3D nucleation during III-V/Si heteroepitaxy and highlight the specific contributions of surfaces and chemically-heterogeneous interfaces in the system [2-7]. On the basis of antiphase boundaries stability calculations, we then demonstrate that monoatomic steps at the Si surface cannot be at the origin of the formation of the antiphase boundaries [8,9]. We thus show experimentally that antiphase boundaries result from the coalescence of monodomain islands, and point out the central importance of the miscut for breaking the symmetry of the system and have an influence on their propagation [9-11]. Finally, we demonstrate how this in-depth understanding can be used to control antiphase domains distributions, and give an experimental demonstration of a quasi-periodic 1D pattern of antiphase domains in a GaAs layer grown on Si substrate [11].

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