Methods of in-situ observation during semiconductor crystal growth by scanning tunneling microscope

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Quantum dots, QDs, are strong candidates for advanced semiconductor quantum devices. However, the precise mechanism of QD growth is not understood, which hampers control over QD size, density and distribution for particular applications. Therefore, in situ evaluation technique for observing the growth process is necessary and indispensable. The techniques, which use the electron beam or light, have already been put to practical use. However, even though the atomic level control for layer by layer growth is enabled, the three dimensions growth cannot be evaluated at atomic-level and real-space by these techniques. Here, scanning tunneling microscope, STM, is good technique to observe the surface in atomic level but it dislikes vibrations and material depositions. So, usually its observation is after transporting the sample from molecular beam epitaxy, MBE, growth chamber to the STM though a gate valve, resulting that the temperature of the sample is returned to room temperature. Since the real in situ observation cannot be done with this ordinary method, we develop STMBE system in which the STM is placed completely inside MBE growth chamber, and with this system, the surface structure is analyzed centering on the in situ STM observation of the InAs QD self-assemble process on GaAs.