Abstract

For the first time I have integrated CdSe nanocrystals (NC) in an epitaxially ZnSe matrix. Wet-chemical growth has been combined with molecular beam epitaxy (MBE) to created complex semiconductor structures with nanocrystals as optic active material. Colloidal NCs have some advantages in comparison to self-organized formed Stranski-Krastanow (SK) quantumdots (QDs). During their organometallic synthesis the size, shape and material can be varied. The SK formation process is thermodynamically driven and therefore the physical properties of the QDs can not be varied independently.

I have shown, that the wet chemical NC synthesis and crystal growth by MBE are compatible. The deposition of NCs on ZnSe-surfaces depends on the residual strain in the ZnSe-layer. On pseudomorphic ZnSe layers NCs tend to cluster. Individual NCs can only be deposited on relaxed ZnSe. However, during the deposition of NCs on the epilayer the epitaxial process must be interrupted.

Both, individual NCs on relaxed ZnSe and NC clusters on strained ZnSe have been overgrown. Reflection high energy electron diffraction has been used to monitor the cap layer growth. It is found to be two dimensional. Transmission electron microscopy and high resolution X-ray diffraction measurements revealed a crystalline cap layer with a moderate density of extended defects. After overgrowth the NC agglomerates are optical active and emit bright luminescence.

The combination of the flexible colloidal chemistry with molecular beam epitaxy opens a new way for the production of semiconductor devices with QDs. The epitaxial overgrowth of NCs allows efficient tuning of the QD density and the emission wavelength. This is advantageous for their application in optoelectronic devices which can cover a broad spectral range.