Poster Presentations

[MS16-P01] Looking into the structure of Ge nano-crystals through diffraction

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Nano-particles of different materials including II-VI (ZnS, ZnO, etc.), III-V (AlN, GaN, etc.) and IV (Si, Ge, etc.) have been applied widely because of their superb optical-electrical properties. More importantly, the size-dependent character of their physical properties due to the quantum confinement effect attracted much research interest during the past decades [1, 2]. The chance of changing size or structure to tune optical properties of Si, Ge, etc. has attracted a lot of research interest in recent years [3, 4] as well. Compared to other materials, Ge is characterized by relatively large Exciton Bohr Radius (≈24nm) [5], which potentially favors the quantum confinement effects for tuning the photoluminescence (PL) properties. Besides, the lower toxicity of Ge suggests potential biological applications such as cell imaging and labeling [1, 6], which is one of the research branches of our group. For the structure characterization of our prepared Ge quantum dots (QDs), we used the in-house X-ray pair distribution function (PDF) machine (X-ray from Ag source with wavelength down to 0.056nm) and Diamond light source synchrotron radiation source (EXAFS, XRD, PL, etc.) to characterize the atomic structure. Several other methods such as TEM and SAED were used to provide a comprehensive picture of ODs on nanoscale. The results showed that our as-prepared Ge QDs are amorphous with small size, and annealing process could attenuate the Ge-O bonding. The PL emission peak in visible region (650-700nm) can be explained due to quantum confinement effect. In aged samples we observed a diffraction peak corresponding to d-spacing around 2.8Å, which can be associated with either ST12 or BC8 metastable phase of Ge.

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