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Photoluminescence Surface Mapping as a Probe for Quantum Well Disorder

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<p>Surface mapping of quantum well structures using photoluminescence measurements is ideal for determining the overall behaviour of such samples with regard to their chemical composition and well-width fluctuations. In some areas where the structural variations are large over a sample, photoluminescence mapping can yield information which would otherwise require several samples to be grown. Well thickness and strain variations across a sample will show as a small spatially-dependent change in the peak energy and the full wave half maximum, so that variations in confinement energies in the QW due to non-uniformity in the film growth can be observed with this method. In this work, spatial variations in the exciton band of photoluminescence spectra were measured using surface mapping of the emission by scanning the sample laterally in the plane of the quantum well across the sample area. The luminescence intensity was then mapped as a function of the emission peak energy (and emission linewidth) and the spatial coordinates x and y, resulting in contour plots.

The results show that knowledge about whether the structures are alloy-disordered or rough (characterised by thickness fluctuations) can be derived through this simple photoluminescence mapping. In rough structures, there is strong correlation between variations in peak energy position and linewidth of the main exciton band. On the other hand, in alloy-disordered structures, there is virtually no correlation between the peak energy and linewidth in comparison to the rough structures. Surface mapping has also revealed variations in peak energy across the rough samples do not only correspond to monolayer fluctuations in well-width, but fluctuations in steps of submonolayers are very common. This explains why thinner QWs give narrower lines compared to thicker ones in these CdSe-ZnSe systems studied here. Further, this analysis shows alloy-disordered structures give good quality samples in terms of optical properties.

Level (Hons, MSc,
   PhD, other)?

PhD

Consider for a student
   award (Yes / No)?

Yes

Would you like to <br> submit a short paper <br> for the Conference
 Proceedings (Yes / No)?

Yes

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