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Critical thickness and phase transition in thin layers grown on crystalline substrates

Content

The effect of threading dislocations as well as the effect of dislocations nucleated from the open surface of growing layer on the misfit dislocation formation are discussed. A brief overview of papers [1,2,3,4] which had a significant impact on mathematical prediction of the critical thickness for dislocation formation in thin layers is presented.

Also, we discuss prediction of various critical thicknesses which altogether limit a layer quality. The layer can be damaged by: (i) phase transition, (ii) fracture and/or (iii) misfit dislocations formation. Each of the phenomena mentioned corresponds to different critical layer thickness. In order to obtain a superlattice, e.g. multiplied quantum wells, of good quality none of the critical thicknesses should be overcome during the growth process.

The analysis concerns the prediction of phase transition phenomena [5] observed in:
(i) the layer deposited as the first one on a bulk crystal as well as
(ii) the layers deposited in a superlattice.

In the case of thin layers grown in a metastable regime the critical thicknesses of subsequently deposited layers differ significantly from each other. The capping of open layer changes the critical layer thicknesses too. In result, the misfit
dislocations formed at the bottom during the layer deposition can stand again up to the threading position after capping [1]. The consequences of such a mode of crystal growth for the resultant quality of thin layers are discussed in brief.

Literature

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Primary author(s) : Prof. DŁUŻEWSKI, Paweł (IPPT PAN)

Presenter(s) : Prof. DŁUŻEWSKI, Paweł (IPPT PAN)

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