CMM-SolMech 2022 conference

S08 Nanomaterials and nanocomposites, their properties and applications

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CRITICAL THICKNESS EVOLUTUTION DURING THE SUBSEQUENT EPITAXIAL LAYERS GROWTH

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The effect of bending of threading dislocations as well as the effect of the nucleation of dislocation half-loops at the surface of growing layer are discussed. A brief overview of several papers [1,2,3,4] which in the speaker opinion had a significant impact on the mathematical prediction of critical thickness of thin layers is presented.

The analysis concerns the critical thickness of (i) the first layer deposited directly on bulk crystal as well as the critical thicknesses of (ii) a layer grown on the previously deposited layers. The critical thicknesses of subsequently deposited layers can differ significantly from each other. Moreover, the capping of open layer changes its critical thickness too. In result, the misfit dislocations already formed at the bottom of uncapped layer can stand again up to the threading position during the capping. The consequences of such a mode of crystal growth on the resultant quality of thin layers are discussed.

Another question discussed is the prediction of various critical thicknesses below which the given layer must be grown to save its good quality. In some specific cases, the layer quality can be damaged by: (i) phase transition, (ii) fracture and/or (iii) misfit dislocations formation. Each of phenomena mentioned results its own critical layer thickness, and in order to obtain a good quality superlattice none of critical thicknesses should be overcome during the growth.

Literature

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