Real-time optical monitoring of thin film growth processes: The characterization of dissimilar heterostructures formation and growth kinetics

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Abstract

The kinetics of nucleation and coalescence of heteroepitaxial thin films is an important step of chemical vapor deposition since it defines the perfection of the heteroepitaxial film both in terms of extended defect formation and chemical integrity of the interface. It also defines the film quality during the later stages of film growth. A combination of real-time monitoring by p-polarized reflectance spectroscopy (PRS) and laser light scattering (LLS) with ex-situ structural characterization techniques is applied to analyze nucleation and coalescence of islands. PRS and LLS are also applied to characterize and control composition and layer thickness of growing heterostructures.

The presentation will give a brief introduction in requirements on real-time optical growth monitoring and demonstrate its strength on the example of compositional and thickness controlled growth of $Ga_{1-x}In_xP$ heterostructures. The second part addresses the optical characterization of gas phase reactions as they play a crucial role for chemical vapor phase depositions utilizing elevated and high pressure conditions. Such emerging techniques are important for the growth of materials with high decomposition pressures as well as for stochiometry control. The last section of the presentation addresses the growth and characterization of chalcopyrite compound semiconductors, which play an important role in nonlinear optical applications.