Nucleation Mechanism of Microcrystalline Si from Amorphous Phase

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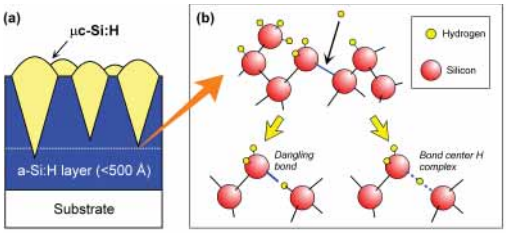
We have characterized surface structures of hydrogenated amorphous silicon (a-Si:H) by applying infrared spectroscopy, in order to investigate the phase transition from a-Si:H to microcrystalline silicon (μc-Si:H). At the onset of μc-Si:H nucleation from the a-Si:H phase, an infrared absorption peak at 1937±5 cm^{-1} assigned to the SiH_n (n=1~2) complex is detected. The SiH_n complex concentration within the a-Si:H surface region showed a clear relationship with the μc-Si:H nucleation. We confirmed that the SiH_n complex, formed by insertion of H into a strained Si-Si bond, contributes to the reactions that result in μc-Si:H nucleus formation.



(a) Cross-sectional structure of μc-Si:H thin film and (b) precursor formation reaction for μc-Si:H nucleation

New Theory for Photoinduced Phase Transitions in Nanostructures

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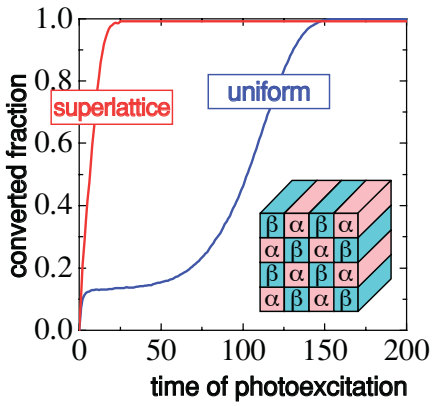
By means of Monte Carlo simulations on a kinetic model, we demonstrate that the efficiency of a photoinduced phase change can in general be enhanced drastically by using a superstructure of an appropriate combination of two components. This is due to the accelerated nucleation of converted domains in the structural blocks relatively close to local instability. The present mechanism provides a general guideline on the design of photocontrollable materials with potential applications for memory and storage devices.



Acceleration of photoinduced phase transition in a superlattice