The Influence of Boron Concentrations on Structural Properties in Disorder Silicon Films

In this work we present a detailed structural study of a series of B-doped hydrogenated microcrystalline silicon (µc-Si:H) films deposited by plasma-enhanced chemical vapor deposition (PECVD) and B-doped polycrystalline silicon (poly-Si) films produced by step-by-step laser crystallization process from amorphous silicon. The influence of doping on the structural properties and structural changes during the sequential crystallization processes were monitored by Raman spectroscopy. Unlike µc-Si:H films, that consist of a two-phase mixture of amorphous and ordered Si, partially crystallized sample shows a stratified structure with polycrystalline silicon layer at the top of an amorphous layer. With increasing doping concentration the LO-TO phonon line in poly-Si shift to smaller wave numbers and broadens asymmetrically. The results are discussed in terms of resonant interaction between optical phonons and direct intraband transitions known as a Fano resonance. In µc-Si:H films, on the other hand, the Fano effect is not observed. The increase of doping in µc-Si:H films suppressed the crystalline volume fraction, which leads to an amorphization in the film structure. The structural variation in both µc-Si:H and poly-Si films leads to a change in hydrogen bonding configuration.

Keywords: Doped microcrystalline and polycrystalline silicon; Laser crystallization; Raman spectroscopy; Hydrogen bonding