Boron Doped a-SiO_x:H Prepared by H₂ Diluted SiH₄+CO₂ Plasma

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doi: 10.20964/2016.12.94

Received: 28 September 2016 / Accepted: 26 October 2016 / Published: 10 November 2016

This paper reports the preparation of hydrogenated amorphous silicon oxide (a-SiO_x:H) thin films by using plasma enhanced chemical vapor deposition (PECVD) technique at various doping ratios of diborane/silane ($R_B=[B_2H_6]/[SiH_4]=0\%$ 、0.75%、1.5%、4.5%、7.5%), and different carbon dioxide/silane gas flow ratios ($R_C=[CO_2]/[SiH_4]=0$ and 1) at a substrate temperature of 200°C ($T_S=200^\circ C$), a process pressure of 220Pa, a hydrogen dilution ratio ($R_H=[H_2]/[SiH_4]=200$) and a power density of $1W\cdot cm^{-2}$. We investigated the effect of various borane doping concentration on the microstructure, optical and electrical properties of as prepared p-type a-SiO_x:H thin films via Raman spectroscopy, X-ray diffraction spectrum, ultraviolet visible light transmission spectrum (UV-VIS) and variable temperature resistance measurement method. It was found that, with the increasing of boron doping ratios, the optical band gap decreases but the refractive index increases. The dark conductivity of doped amorphous films increases monotonously with the increasing of boron doping content, while the dark conductivity of doped a-SiO_x:H films is not only determined by the concentration of dopant but also the crystallinity and oxygen content of the films. As increasing R_B , the crystallinity of doped μc -Si:H and a-SiO_x:H films simultaneously decreases, which causes the decrease of dark conductivity. Finally, B-doped a-SiO_x:H thin films with a highest dark conductivity of $0.048\ \Omega^{-1}\cdot cm^{-1}$ have been prepared.

Keywords: Hydrogenated amorphous silicon oxide; Boron doping ratio; Dark conductivity; Activation energy.

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