

High quality fast growth nano-crystalline Si film synthesized by UHF assisted HF-PECVD

Youn J. Kim, Yoon S. Choi, In S. Choi, Jeon G. Han

Center for Advanced Plasma Surface Technology, Sungkyunkwan University

A high density ($> 10^{11} \text{ cm}^{-3}$) and low electron temperature ($< 2 \text{ eV}$) plasma is produced by using a conventional HF (13.56 MHz) plasma enhanced chemical vapor deposition (PECVD) with an additional ultra high frequency (UHF, 314 MHz) plasma source utilizing two parallel antenna assembly. It is applied for the high rate synthesis of high quality nanocrystalline silicon (nc-Si) films. A high deposition rate of 1.8 nm/s is achieved with a high crystallinity ($< 70\%$), a low spin density ($< 3 \times 10^{16} \text{ cm}^{-3}$) and a high light soaking stability (< 1.5). Optical emission spectroscopy measurements reveal emission intensity of Si* and SiH*, intensity ratio of $H\alpha / \text{Si}^*$ and $H\alpha / \text{SiH}^*$ which are closely related to film deposition rate and film crystallinity, respectively. A high flux of precursor and atomic hydrogen which are produced by an additional high excitation frequency is effective for the fast deposition of highly crystallized nc-Si films without additional defects.