A study on effect of electron beam irradiation in the oxidized poly-Si1-xGex films

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Abstract

We have observed the microstructural and compositional changes occurred in oxidized poly-Si1-xGex film during the electron-beam irradiation in the Transmission Electron Microscope. Two sets of 1000Å-thick poly-Si1-xGex films with different Ge content (40 and 60%) were deposited using ultra-high-vacuum chemical vapor deposition (UHV-CVD) system (EUREKA 2000, Ju-sung Co. Ltd) on the 8-inch wafers on which a 1000 Å thick SiO2 layer had been thermally grown. After deposition of poly-Si1-xGex films, the oxidation was carried out in dry ambient at 800℃ by using conventional tube furnace. Cross sectional samples of oxidized poly-Si1-xGex films were exposed to electron-beam irradiation with kinetic energy of 300keV in the TEM. (JEM-3011, LaB6 cathode, Jeol Co. Ltd)

Before irradiation, there is no specific features observed in the oxide layer and it seems that the oxide layer is to be homogenous. (see Fig. 1(a), Fig. 2(a)) However, during the electron-beam irradiation, significant changes in microstructure and elemental distribution were occurred. For the oxidized poly-Si0.6Ge0.4 films, a thin layer of dark contrast can be clearly observed at the oxide surface. And, there are a number of dark contrast islands at the region just below the surface. (see Fig. 1(b), 1(c)) In the case of the oxidized poly-Si0.4Ge0.6 films, in contrast, the oxide layer is divided into two regions that show different contrast, which is similar to the result of the oxidized poly-Si0.6Ge0.4 films. (see Fig. 2(b), 2(c)) In addition, the surface roughness of the oxide layer is getting increased as the irradiation time increases. The thickness of the oxide layers before and after the irradiation are measured to be about 830Å and 700Å, respectively. The thickness of oxide layer is decreased as the irradiation time increases.

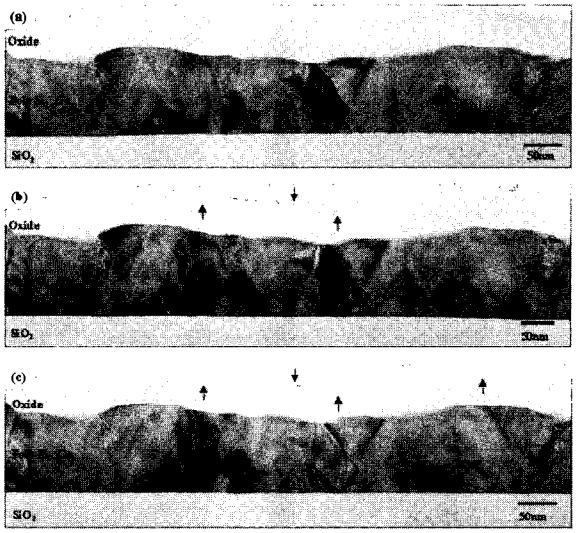

Fig. 1 Cross sectional TEM micrographs of the Poly Si0.6Ge0.4 films after dry oxidation at 800℃ for 120min. (a) before irradiation, (b) after irradiation for 10min., (c) after irradiation for 15min.

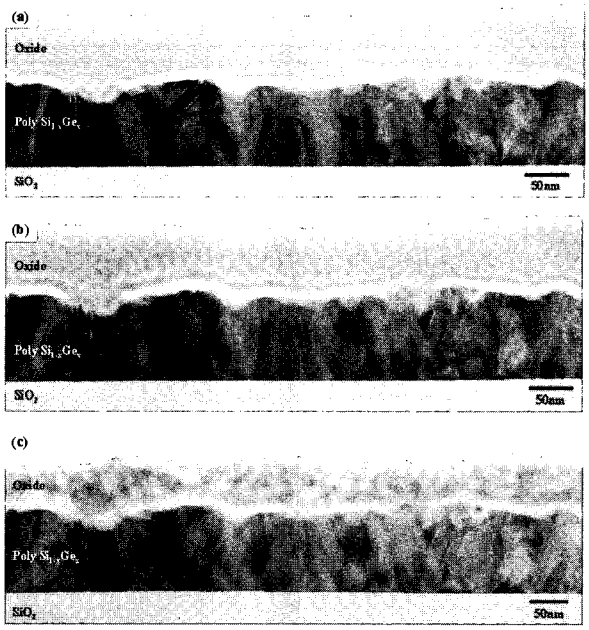

Fig. 2 Cross sectional TEM micrographs of the Poly Si0.4Ge0.6 films after dry oxidation at 800℃ for 20min. (a) before irradiation, (b) after irradiation for 5min., (c) after irradiation for 10min.