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Characteristics of cluster eliminating filter for plasma CVD

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Hydrogenated amorphous silicon (a-Si:H) nanoparticles below 10 nm in size (clusters) are formed in CVD plasmas for a-Si:H film deposition and some of them are incorporated into a-Si:H films, leading to light induced degradation of the films [1]. Recently, highly stable a-Si:H films have been deposited by suppressing incorporation of clusters using a cluster eliminating filter together with a multi-hollow discharge plasma CVD reactor [2]. Here we study dependence of cluster eliminating filter on filter pitch size for further stability improvement.

The deposition experiments were carried out by setting high resistivity Si substrates in the upstream region from the electrode in the multi-hollow discharge plasma CVD reactor. Cluster eliminating filters were set between the electrode and substrates. SiH_4 was fed from the bottom of the chamber at 56 sccm, then flew thorough the hollows. The total pressure was 0.08 Torr. High frequency discharge voltage of 120 MHz was applied to the powered electrode. The discharge power was 20 W. Substrate temperature was set at 180 °C. Hydrogen content in films was measured by Fourier transform infrared spectroscopy (FTIR).

Figure 1 shows dependence of hydrogen content associated with SiH and SiH_2 bonds in films on filter pitch size. Cluster eliminating filter significantly reduces hydrogen content associated with SiH_2 bonds in films. Hydrogen content associated with SiH and SiH_2 bonds in films increase from 3.5 at. % and 1.1 at. % for 2.5 mm pitch filter to 11.5 at. % and 4.3 at. % for 7.5 mm pitch filter, and then decrease to 3.0 at. % and 0.85 at. % for 20 mm pitch filter. These results suggest that we can control the amounts of Si-H and Si-H_2 bonds in films by filter pitch size.

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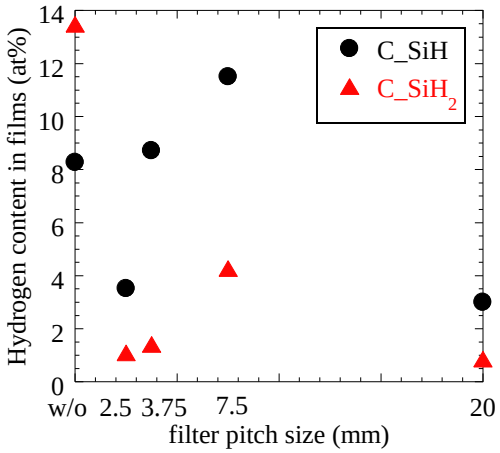

Fig.1 Dependence of hydrogen content associated with SiH and SiH_2 bonds in films on filter pitch size.

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[2] K. Koga, N. Kaguchi, K. Bando, M. Shiratani, and Y. Watanabe, Rev. Sci., Instrum., **76** (2005) 113501.