

PO1010

Characterization of a-SiC:H thin films prepared by PECVD from the point of adhesion

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Thin films characterization from the point of adhesion is mainly done by nanoscratch test. Possibilities of application can be determined by adhesion between substrate and thin film prepared e.g. PVD or CVD. In this case, adhesion of thin films of amorphous hydrogenated silicon carbide (a-SiC:H) to the silicon wafer substrate was studied. Industrial applications of this research could be in the field of composites without interface and protective coatings. Thin films were deposited from pure tetravinylsilane monomer (TVS) by plasma-enhanced chemical vapor deposition (PECVD). The substrates were pretreated with argon plasma (10 sccm, 5.7 Pa, 5-200 W) using continuous wave for 10 min to clean the surface from adsorbed gases and reach reproducible adhesion of thin films. Plasma depositions of films were done in two regimes - pulsed plasma and continuous wave (3.8 sccm, 2.7 Pa). Range of the power during the depositions was between 2 and 150 W for pulsed plasma and 10 and 70 W for continuous wave. Prepared films were evaluated by nanoscratch test with maximum peak load up to 10 mN and the length of 10 μm . Scratch testing was done by diamond indenter (90 $^\circ$) with radius 1 μm . One thickness series and two power series were tested. The thickness series deposited at a constant power of 2 W shown that values of critical load linearly increased from 1.3 mN to 9.2 mN with increasing thickness in range 33 nm – 666 nm. Because of this fact, the thickness of the film from power series was around 100 nm. We revealed for pulsed plasma that the critical load increased with enhanced power from 1.6 mN (2 W) up to 4.6 mN (75 W) and it was invariable for higher power, i.e., 4.4 mN (150 W). The samples which were prepared in continuous wave shown also increasing trend from 1.8 mN (10 W) up to 4.0 mN (50 W) and 3.9 mN for 70 W. It means that higher values of critical load are for continuous wave in range 20 W – 50 W and 75 W and 150 W for films prepared by pulsed plasma. The adhesion of the films was observed for 1500 days without aging effect.

Keywords

adhesion
scratch test
PECVD
thin films