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Effects of the pressure and the self-bias voltage on the doped and undoped amorphous hydrogenated carbon films properties

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Abstract – In this work, we investigated the effects of the pressure (4 and 10 Pa) and the self-bias voltage (from -100V to -600V) on a-C:H, a-C:N:H and a-C:F:H films properties

The structural and mechanical properties of amorphous carbon films are controlled by the ion assistance during the film growth. In plasma enhanced chemical vapor deposition (PECVD) process this assistance is determined by the combination of the self-bias voltage and the precursor atmosphere total pressure. In this work, we reported results of deposition rate, film composition and atomic density determined by ion beam techniques, film microstructure as revealed by Raman spectroscopy and the film stress obtained from nitrogen (a-C:H:N) and fluorine (a-C:H:F) carbon doped films. We investigated the effects of the self-bias voltage in the range from -100V to -600V at different pressures (4,0 and 10 Pa). To obtained a-C:N:H films by PECVD we employed a N2-CH4 (2:3) mixture and for the a-C:H:F films a CF4-CH4 (2:1) mixture. The results show a progressive reduction of the hydrogen content upon the increase of the self-bias voltage while the nitrogen remains constant and the fluorine increases. The films density shows a broad maximum centered at around -350 V for a 4,0 Pa total pressure. The internal stress as a function of the bias shows a broad maximum centered at the nearly the same self-bias voltage for all investigated pressures and films. The results were discussed in terms of the combination of two mechanisms: the subimpantation process and the graphitization observed for the high energy bombardment regime.

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