PO3054

Highly tetrahedral amorphous carbon films deposited by high power impulse magnetron sputtering under an externally applied pulsed magnetic field

Rajesh Ganesan[1], Benjamin Treverrow[1], Stephen Bathgate[1], Dougal. G. McCulloch[2], David. R. McKenzie[1], Marcela. M.M. Bilek[1]

[1]The University of Sydney, Sydney, Australia [2]RMIT University, Melbourne, Australia

rajesh.ganesan@sydney.edu.au

Highly tetrahedral amorphous carbon (ta-C) films have been prepared by high power impulse magnetron sputtering on the Si substrates suspended perpendicular to the target substrate central axis. In all ta-C depositions reported so far, application of a bias voltage to the substrate holder is necessary to place the energy widow of the carbon ions within the optimum range, 100eV, for creating the highest sp^3 fraction. When it is desired to apply ta-C coatings to insulating substrates, it may not be convenient or possible to apply large voltages of order 100V to the substrate. It would be of practical interest to provide a deposition source that achieves the optimum energy without the need for bias, so that the material can readily be applied to both conducting and insulating substrates. In this work, we show that the optimum energy of carbon ions for ta-C formation with the highest sp^3 content can be obtained in another way, with the use of a current carrying coil placed between the graphite target and the substrate holder. We will show how the mixed mode HiPIMS sputtering process can be adapted using such a pulsed magnetic field configuration to deposit ta-C films with the optimum sp^3 fraction and without biasing the substrate to -100 V. When the current of 120 A is drawn through the coil, the deposition rate is increased by a factor of 2.6 for a sample placed on the target-substrate central axis, owing to the enhanced transport of ion deposits transported by the magnetic flux from the target region to the substrate. The gradual increase in the sp^3 fraction and the density of the films with distance closer to the target-substrate central axis is thought to be the due to the energetic impact of confined ion deposits on the central axis region. Whereas reduction in the energy and the flux of ion deposits as a function of position away from central axis produces less intrinsic stress, which reduces the sp^3 fraction and density of the films.

Keywords
HiPIMS
amorphous carbon
pulsed magnetic field
ion transport