AN EXPERIEMENTAL STUDY OF ALUMINIUM (AL) INCORPORATED DIAMOND LIKE CARBON (DLC) THIN FILMS

Kanak Kalita[1], Ranjan Kumar Ghadai[2]

[1] Department of Mechanical Engineering, Vel Tech Rangarajan Dr.Sagunthala R&D Institute of Science and Technology, Avadi, Chennai, India
[2]Department of Mechanical Engineering, Sikkim Manipal Institute of Technology, Sikkim Manipal University, Majitar, Rangpo-East Sikkim, 737136, India
kanakkalita02@gmail.com

In the present work Aluminium (Al) incorporated Diamond like Carbon (DLC) thin films have been synthesized over Si(100) substrate using Atmospheric pressure chemical vapour deposition (APCVD) technique with variation in deposition temperature and keeping the N_2 flow rate constant. The morphology, corrosion behavior and mechanical properties of the thin films were characterized by Scanning Electron Microscope (SEM), Atomic force microscopy (AFM), corrosion test and nano-Indentation. SEM results revealed the smooth surface morphology of the coatings grown at different process temperatures. The surface roughness of the Al-DLC coatings was observed in the range of 20µm to 36µm and it is found to be increased with increasing in the deposition temperature. The corrosion resistance of the coating found to be decreased with increase in the deposition temperature and this could be due higher randomness of gaseous molecules at high temperatures. The nano indentation result revealed that the coating Hardness (H) and Young's Modulus (E) were increased with increasing the deposition temperature. The parameters H/E and H_3/E_2 indicated the elastic–plastic property exhibited by the coating and it also provides the wear properties of the films. The residual stresses have been calculated by using Stoney's equation and it is observed that residual stress of the film decreases with the increase of deposition temperature.

The SEM images of the Al-DLC coated samples prepared at different CVD process temperature has been shown in Fig. 1. The SEM images revealed a smooth coating for all the samples grown at different process temperatures. However, through SEM technique no particular pattern of the grains was observed. The morphology of the coating prepared at 920 ℃ showed white colour spot over the surface. This spot may be attributed to white agglomerated particles that could have deposited at the time of deposition due to partial melting and evaporation of the powder particles. The coatings were observed with negligible pores and inclusions. In past research works it is reported that the morphology of the coatings greatly depends upon atom diffusion, deposition and etching effect [1, 2]. The proper estimation of grain size or particle size the coatings were further characterized by AFM technique. The composition of various elements of Al-DLC coatings prepared under various process temperatures has been presented in Table 1. EDS result revealed that with increase in process temperature from 800 ℃ to 920 ℃ the atomic % of carbon increases and aluminium decreased.

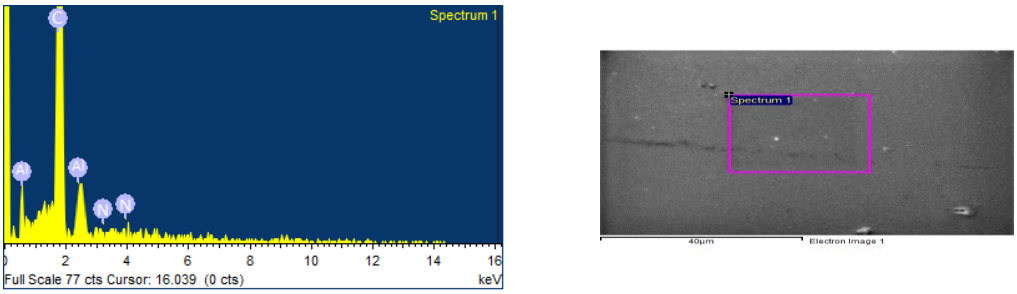

Fig. 1 EDS analysis of Al-DLC coating grown at 800 ℃ using APCVD.

Table 1. Composition of various elements of Al-DLC thin film estimated from EDS technique.

Sample No	% of Carbon	% of Al	% of Nitrogen
Al-DLC 800	90.46	9.12	0.42
Al-DLC 840	91.26	8.18	0.56
Al-DLC 880	91.61	8.03	0.36
Al-DLC 920	90.31	9.16	0.53

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