Closed Field Unbalanced Magnetron Sputtering Ion Plating of DLC and Si-DLC Films onto Nitrile Rubber

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Abstract

In this study, diamond-like carbon (DLC) and Silicon doped DLC (Si-DLC) have been deposited on acrylonitrile butadiene rubber (NBR rubber) via a closed field unbalanced magnetron sputtering ion plating (CFUBMSIP) system at a bias voltage of − 30V. Comparison was made for DLC and Si-DLC films deposited with and without a Si-C interlayer. A sputter cleaning system was integrated into the deposition process so as to have no time for recontamination between the cleaning and deposition stages. The results show the presence of a micro-crack like network of the films on NBR rubber. A non-columnar coating is formed that promoted the generally good adhesion between the films and the NBR substrate. For films with Si-C interlayer an adhesion rating of 4A is observed. The composite micro-hardness was highest for DLC films at 15.5 GPa for an indentation load of 147.1 mN. The inclusion of the Si-C interlayer generally tended to increase the intensity ratio (ID/IG) for both DLC and Si-DLC films. The increase in the sp2 content was a result of the Si-C interlayer. The hybridization of carbon in terms of sp2 and sp3 bonding was used to explain these results. This study is motivated by the potential of applying DLC and Si-DLC films onto actual piston seals used in handpumps for rural water supply in sub-Saharan Africa.

Keywords: *DLC film; Magnetron sputtering; Raman spectroscopy*