Design and development of highly robust hydrophobic plasma polymer film on glass substrate

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A promising method for enhancing the efficiency of self-cleaning glasses and solar cells is to fabricate hydrophobic surfaces with a low coefficient of friction [1,2]. To achieve this goal, (F, Si) hydrogenated carbon film on a glass substrate was produced using plasma-enhanced chemical vapor deposition (PECVD). To elucidate the performance of the (F, Si) carbon film, it was compared to diamond-like carbon (DLC) films doped with different elements, such as fluorine and silicon. Raman spectroscopy revealed that Si-doped DLC (Si-DLC) film has the highest sp^3/sp^2 ratio of carbon hybridization, while fluorine-doped DLC (F-DLC) film has the lowest sp^3/sp^2 ratio of carbon hybridization, both of which affect the mechanical properties of the films. The X-ray photoelectron spectroscopy (XPS) showed that SiC can be formed by incorporating silicon into the DLC film. In addition, CF_2 and CF_3 groups are created in fluorinated samples such as F-DLC and (F, Si) carbon films. Due to the highest surface concentration of CF_2 and CF_3, the (F, Si) carbon film exhibited the strongest hydrophobic behaviour (Fig. 1). Nano-scratch and nanoindentation tests were used to analyse the nanomechanical behaviour of the films. The Si-DLC film had the highest adhesion strength, whereas the (F, Si) carbon film displayed the lowest coefficient of friction. The adhesion strength of the (F, Si) carbon film was comparable to that of the Si-DLC film because the Si-DLC film was deposited as a sub-layer of the (F, Si) carbon film. The highly robust hydrophobic (F, Si) carbon film fabricated in this study shows potential for the surface engineering of self-cleaning glasses.

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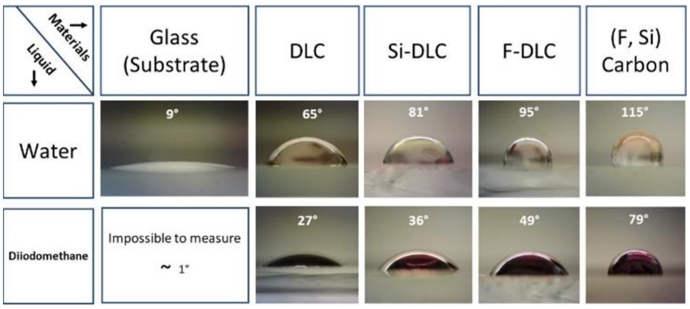

Fig. 1. Water and diiodomethane contact angles of the glass substrate and the films.

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