Tuning the work function of graphene oxide using a low power atmospheric pressure plasma jet

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In this study, a new technique for doping graphene oxide (GO) films using a low power (4W) atmospheric pressure plasma jet (APPJ) is proposed. The reactive nitrogen species in the plasma is found to induce finite changes in the surface chemistry and electronic properties of GO films. Nitrogen introduced by the atmospheric pressure plasma is predominantly in a graphitic configuration with a varying concentration of pyridinic nitrogen. X-ray photoelectron spectroscopy showed that GO underwent gradual de-epoxidation with increasing plasma exposure. Also, the excess electron of nitrogen significantly distorts the valence band density of states of GO. In addition to these findings, Kelvin probe studies revealed that the bonding configuration can influence the work function of GO. With plasma functionalization, the work function of GO could be varied by 120 mV. With pyridinic nitrogen the electronic states of GO became electron deficient, inducing a p-type doping and increase in graphitic nitrogen increased the electron density of GO leading to an n-type doping effect. These findings are extremely useful in fabricating heterojunction devices like perovskite solar cells, where GO is used as a charge transport layer and can be extended to other known 2D systems as well. [1]

References

[1] Dey, A., Chroneos, A., Braithwaite, N. S. J., Gandhiraman, R. P., & Krishnamurthy, S. (2016). Plasma engineering of graphene. Applied Physics Reviews, 3(2), 21301.

Figures

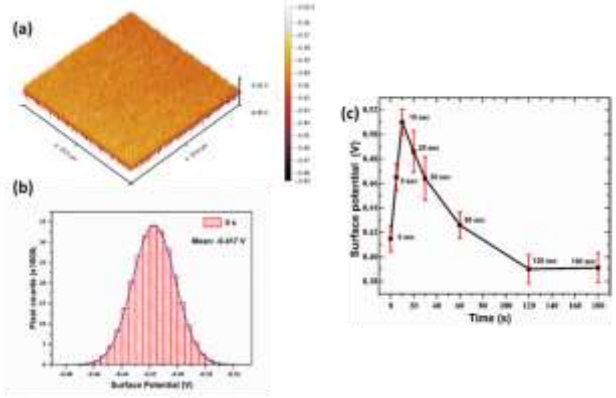

Figure 1: (a) SP map (b) Histogram plot of SP distribution of the refence GO sample. (c) Variation in surface potential of GO with duration of APPJ treatment.

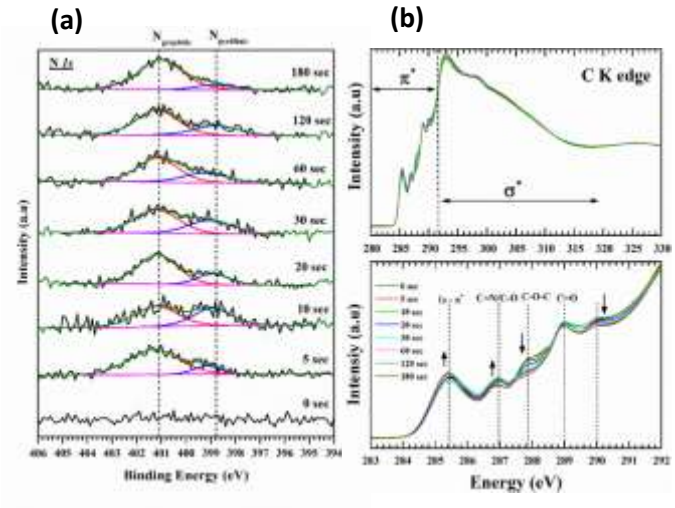

Figure 2: (a)Fitted N1*s* spectra, showing variation in the nitrogen configuration. (b) C K-edge NEXAFS spectra, revealing epoxide ring opening via nucleophilic attack.