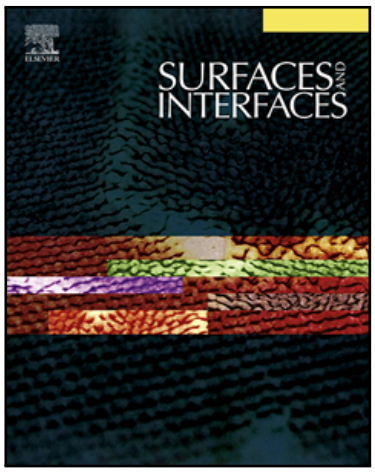

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Ultrathin film of carboxylated graphene at air-water and air-solid interfaces

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Abstract

Ultrathin films of graphene and functionalized graphene is drawing scientific attentions due to its potential for industrial application. Due to the ease of processing and device fabrication, and enhancement in the molecular-specific interaction during sensing, graphene can be chemically modified to yield functionalized graphene. The ultrathin Langmuir-Blodgett (LB) films of nanomaterials show enhanced performance as compared to that of thick film. Such enhancement is attributed to the remarkable increase in surface-to-volume ratio and some ordering of the nanomaterials in the LB film. In this article, we report our studies on Langmuir film (LF) and LB film of carboxylated graphene (G-COOH) at air-water (A/W) and air-solid interfaces, respectively. The LF of G-COOH at the A/W interface exhibited gas and liquid-like phases. The liquid-like phase was found to be stable and reversible. The LF of G-COOH at the A/W interface is found to interact strongly with urea in the aqueous subphase via electrostatic interaction. This indicated that the LB film of G-COOH can be employed for sensing urea in aqueous medium. A functional layer of LB film of G-COOH is fabricated onto quartz wafers of a quartz crystal microbalance and the sensing performance towards urea in aqueous medium was studied. The sensing performance was compared with spin coated film of G-COOH. The lowest detectable concentration of urea using LB film of G-COOH (8.3 μM) is about 5 times lower than that of spin coated film (41.6 μM) and at the same time the sensitivity due to LB film (42.5 ng/cm^2/μM) is about 3 times better than that of spin coated film (12.9 ng/cm^2/μM). The similar protocol was employed for sensing urea in milk. The sensitivity of urea in milk by LB film of G-COOH is found to be about 5 times better than that of spin coated film of G-COOH. This study clearly indicates the potential of LB film of G-COOH as a sensitive and low concentration detectable urea sensor.

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