Graphene-based sensors for environmental monitoring

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Interest in low-cost sensors for detecting pollutants in indoor and outdoor environments has grown in recent years due to increased awareness of the harmful effects of these pollutants on health. As an extremely sensitive electrical transducer of molecular adsorption, graphene is an ideal platform for creating miniature sensors with unprecedented sensitivity.

To make such sensors selective to different gases, we developed the design principles of oxide-on-graphene structures using experimental and DFT methods. We functionalised single-layer graphene with a variety of ultrathin (down to 0.5 nm) oxide coatings (ZrO_2, V_2O_5, TiO_2, In_2O_3, Sc_2O_3, $CuMnO_3$) by pulsed laser deposition.

An overview of graphene-based gas sensors for environmental applications is given. Based on principles derived from empirical and theoretical data, we fabricated sensor arrays with different oxide-on-graphene structures. By applying machine learning to the array signals, different air polluting gases were simultaneously detected: NH_3 and H_2S, NO_2 and O_3.

Graphene is an excellent platform for creating miniature air quality sensors. Its full potential in environmental monitoring is further to be explored, together with related 2D materials and different functionalisation strategies.

References
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