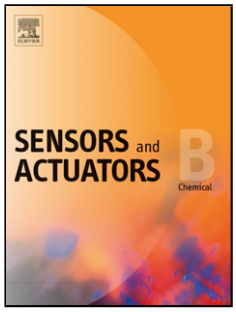

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Enhancing the response of NH_3 graphene-sensors by using devices with different graphene-substrate distances

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Highlights

- Graphene sensing properties are highly dependent of the target gases;
- The performance of graphene devices is considerably affected by its substrates;
- The ammonia sensing is dependent of the distance of separation between graphene and the substrates;
- The graphene-ammonia sensors exhibit two different adsorption processes for ammonia molecules: one at the top of the graphene surface and another at its bottom side close to the substrate.
- Ammonia detection is highly desirable for commercial applications;

Graphene (G) is a two-dimensional material with exceptional sensing properties. In general, graphene gas sensors are produced in field effect transistor configuration on several substrates. The role of the substrates on the sensor characteristics has not yet been entirely established. To provide further insight on the interaction between ammonia molecules (NH_3) and graphene devices, we report experimental and theoretical studies of NH_3 graphene sensors with graphene supported on three substrates: SiO_2, talc and hexagonal boron nitride (hBN). Our results indicate that the charge transfer from NH_3 to graphene depends not only on extrinsic parameters like temperature and gas concentration, but also on the average distance between the graphene sheet and the substrate. We find that the average distance between graphene and hBN crystals is the smallest among the three substrates, and that graphene-ammonia gas sensors based on a G/hBN heterostructure exhibit the fastest recovery times for NH_3 exposure and are slightly affected by wet or dry air environment. Moreover, the dependence of graphene-ammonia sensors on different substrates indicates that graphene sensors exhibit two different adsorption processes