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Screening of charge impurities and defects: alternative mechanisms for the detection of gases on graphene and nanotubes[1]

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In gas detection with carbon nanotubes or graphene, the change in conductivity due to molecular adsorption has been attributed to changes in carrier density due to charge transfer. However, these explanation does not take into account several physical effects. 1) The counter-ions left after the charge transfer process lower the mobility and might compensate the effect of extra carriers. 2) The experimental results are not consistent with variations in the ionization potential or electron affinities of the adsorbates. We explore alternative explanations to this observations. One is based on the screening produced by the molecules on the charge impurities of the substrate. Given that the scattering with these impurities is the main limiting factor of the conductivity, the change in screening produced by the molecules has a substantial effect on the conductivity. Using the dielectric function of graphene at the RPA level and the impurity scattering in the first Born approximation. We explain the increase in conductivity. Another mechanism is the effect of lattice imperfections and their interaction with the detected molecules. Changes in the conductivity produced by vacancies, and chemisorbed molecules are calculated and correlated with the experimental measurement.

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