GRAPHENE OXIDE – METAL OXIDES NANO-HETEROJUNCTIONS FOR LOW TEMPERATURE SENSING: AN EXPERIMENTAL AND THEORETICAL APPROACH

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Breakthroughs in the synthesis of hybrid materials have led to the development of a plethora of chemiresistors that could operate at lower and lower temperatures [1]. Nowadays, the research attention has been focused on the detection of Volatile Organic Compounds (VOCs) either for environmental concern as toxic species, or for medical diagnosis of humans' diseases [2]. Among the metal oxide semiconductors, SnO_2, ZnO and WO_3 have been widely investigated for the sensing of both inorganic and organic species. However, they still suffer from some problems, especially connected with their high operating temperatures [3].

Hence, the present work will be aimed at both optimizing the synthetic routes of *ad hoc* composite VOCs sensing materials, to be exploited as chemiresistors, and deeply unravelling the relationship between resistivity variations and microscopic gas adsorption mechanism, by theoretical simulations.

Starting from pure graphite, graphene oxide (GO) powder was synthesized by adopting the Hummer's modified method. The synthetic route was investigated by modulating both the starting carbon material (powder or flakes graphite) and the concentration of the H_2O_2 (*i.e.* the quenching/oxidizing agent), thus tailoring the final GO surface/structural properties. Once optimized this step, SnO_2, ZnO or WO_3 were grown on its surface by hydrothermal method, varying the starting salt precursor/GO weight ratio between 4 and 32. For comparison, pure metal oxides were also tested. Several physico-chemical techniques have been used to characterize all the as-prepared nanopowders. Subsequently, a homogeneous layer was deposited by spraying technique onto Pt-Interdigitated Electrodes (Pt-IDEs) starting from an ethanol suspension of each sample (2.5 mg mL^{-1}, Figure 1). Then, gaseous acetone and ethylbenzene were sensed, obtaining very promising results (in terms of both response/recovery time and sensibility down to ppb levels) for either pure or hybrid materials at 350°C, and at lower temperatures (150°C to 30°C, exploiting the UV light) for the graphene-based samples.

Finally, a possible gas adsorption mechanism was proposed on the basis of the preliminary theoretical studies.

References

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