Application of Reduced Graphene Oxide Based Hybrid Functional Nanomaterials in Vapour Sensors for Human Health Monitoring

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Abstract: Cancer kills more than seven million people every year. The current 5-year survival rate for lung cancer is 15 %, but this rate may rise to 49 % if the cancer could be diagnosed when it is still localized [1]. Since the survival of cancer patients depends on early detection of tumour cells, developing technologies applicable for rapid detection of carcinoma is a challenge for the researchers. Breath testing has emerged as a noninvasive technique for anticipated diagnosis of lung cancer, as the breath extract of lung cancer patients are found to display elevated levels of several volatile organic compounds (VOC) such as C_4 to C_{20} monomethylated alkanes, in addition to certain benzene derivatives [2]. Clearly, the invention of a fast, reliable, economic and portable technique is highly required before breath testing become a clinical reality. Nanomaterial based sensor arrays can fulfill all these requirements and can form a solid foundation for identification of disease related VOC patterns in exhaled breath [3]. In the present study, a novel chemo-resistive vapour sensor, comprising of functionalized β cyclodextrin-reduced graphene oxide hybrid transducer has been developed. This hybrid functional material can exploit the combined benefits of high specific surface and good electrical conductivity of graphene as well as host-guest inclusion complex formation ability and variable selective chemical modification of β cyclodextrin. The sensing performance of electronic nose composed of 3 types of functionalized CD wrapped graphene sensor along with one pristine graphene and one pyrene adamantan linked graphene sensor were analysed, after being exposed to 11 selected cancer biomarker VOC's. The specific functionality of CD is found to be a predominant influencing parameter to tune the specific molecular selectivity of the sensors used in the electronic nose. The present study therefore opens a novel approach to achieve distinct selectivity of the chemical vapour sensors for specific VOC's by employing functionalized CD modified reduced graphene oxide hybrid functional nano-material as chemical vapour sensor.

Key Words: Cyclodextrin; Graphene; Nanomaterial; Biomarker; Vapour Sensor

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4.

Figures:

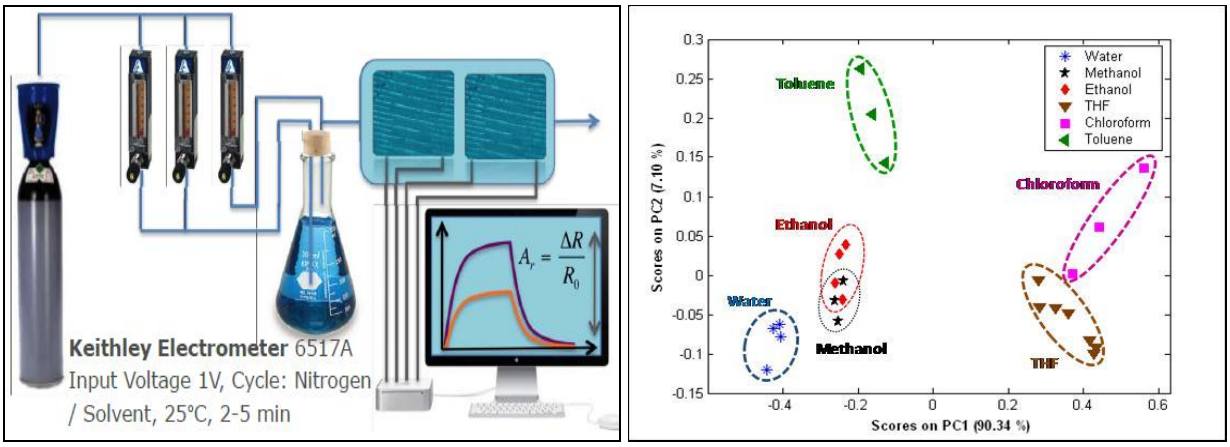

Fig. 1 (a) Instrumental set up of dynamic vapour sensing (b) Discrimination of mixture of VOC's by PCA mapping

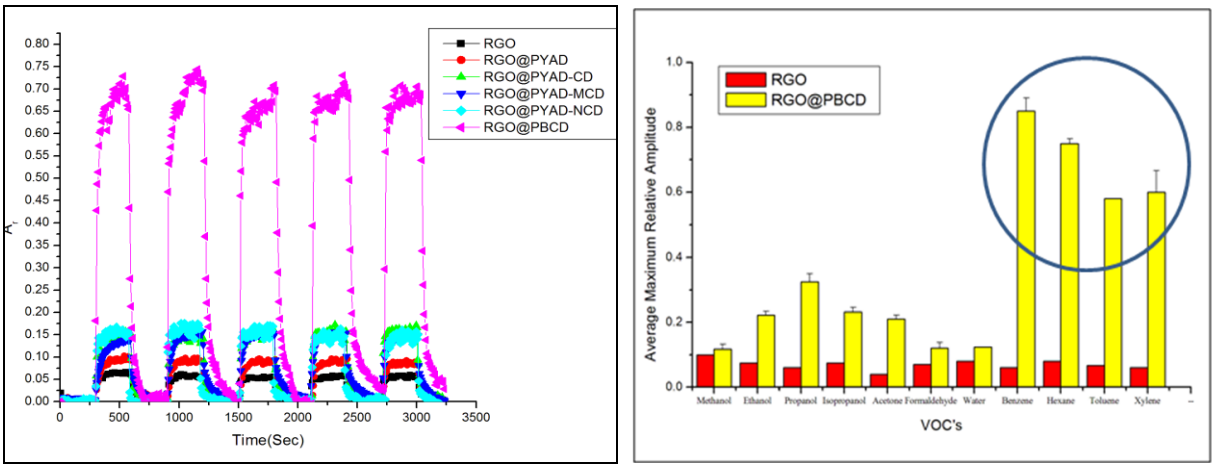

Fig.2 (a) Chemoelectrical response of a set of 6 sensors in a benzene (b) benzene selectivity of functionalized cyclodextrin wrapped graphene sensor