Partially reduced Graphene Oxide based wireless sensor

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Graphene based structures such as Graphene Oxide (GO) and reduced Graphene Oxide (rGO) have been widely applied for resistive gas sensing applications [1]. However, few designs are performed using pervasive and non-intrusive methods, which are important in applications where intervention can be an issue. This work presents a low-cost chipless RFID [2] inspired wireless alcohol vapour sensor based on a miniaturized metamaterial (MTM) antenna loaded with partially reduced Graphene Oxide (prGO). Finite Element Method (FEM) simulations are performed in order to choose the best place to deposit prGO. The simulated gain and radiation efficiency are 8.65 dBi and 69 %, respectively. It is observed that the structure responds to a variation on prGO sheet resistivity only for a certain range of values, as shown in Fig 1. The necessary thermal reduction time to achieve this spectrum of values is experimentally found to be between 60 and 90 min. 10 uL of Modified Hummer's method GO is then deposited on the antenna structure and annealed for 60, 75 and 90 min. The measurement setup consists of antenna reflection coefficient measurement at 9 GHz using a Scalar Network Analyzer. After stabilization, isopropyl alcohol vapour is put in contact with the sample in a closed container, and the response is observed. The best measured sensitivity result is 11.41% for the 90 min prGO sample.

References

[1] Wang, Tao, et al., Nano-Micro Letters, 8.2 (2016): 95-119.
[2] Tedjini, Smail, et al., IEEE Microwave Magazine, 14.5 (2013): 56-65.

Figures

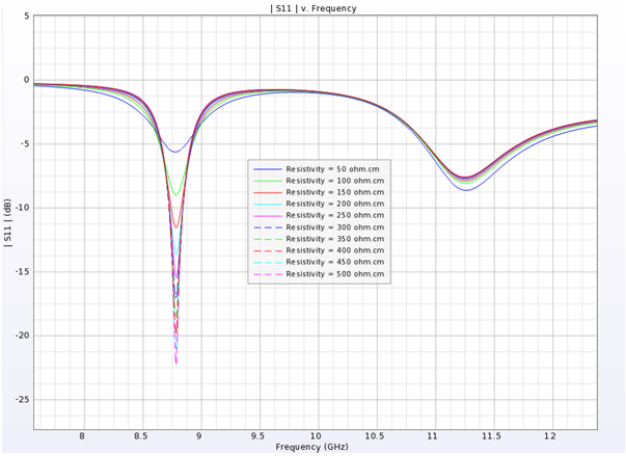

Figure 1: Reflection Coefficient FEM simulations for different resistivities of a sheet used to emulate prGO. For greater values, there is no response, and for smaller values the response is too deteriorated.

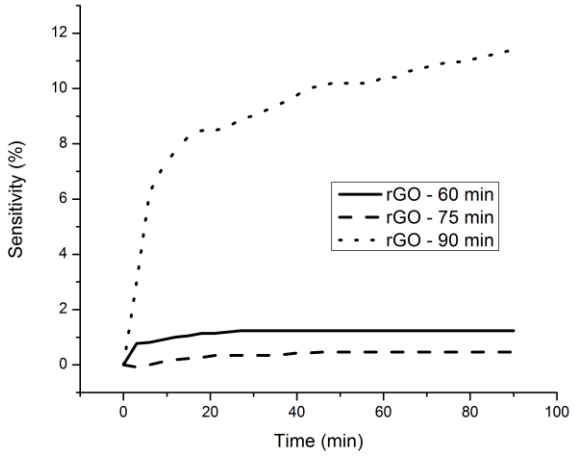

Figure 2: Measured sensitivity versus time of the three implemented sensors. As can be seen, the 90 min sample showed the best performance.