Development of a graphene based ammonia and NOx gas sensor.

Vincent Malesys[1]
Amandine Andrieux-Ledier[1], Pierre Lavenus[1], Laurent Simon[2]

1. *Onera, 29 Avenue de la Division Leclerc, 92320 Châtillon, France*
2. IS2M, 3 bis rue Alfred Werner, 68093 Mulhouse, France

Vincent.malesys@onera.fr

Graphene has been demonstrated as a promising material for the development of ultrasensitive gas sensor thanks to its exceptional properties especially its low electronic noise [1]. A graphene based sensor should achieve a molecular sensitivity.
In this context, Onera, is pushing for the development of an ammonia and NOx sensor. This gas sensor relies on the chemosensitivity of the graphene when exposed to a gas. It is produced by several steps of photo-lithography and graphene transfer.
Firstly, we worked on the reliability of the manufacturing process with a particular attention to the graphene implementation. We compared three graphene transfer methods: electrochemical delamination [2], oxidative delamination [3] and copper etching [4]. For this purpose, we used three comparative techniques: microscopy (morphology, see Fig.1), Hall measurement (electrical properties, see Fig.2) and Raman spectroscopy (crystallinity). This led us to choose copper etching as being a repeatable transfer method.
Currently, we intend to simplify the photo-lithography process, either by reducing the number of steps or by moving from a top contact method to an edge-contact method. These will enhance both graphene quality and electronical response of the sensor through better contact resistivity [5].
As a coming step of this research, we are willing to implant fluorine atoms into the pristine graphene section [6], with the aim of detect both ammonia and nitrogen dioxide molecules. Indeed the electron affinity between the ammonia molecule and the fluorine combined with the high electronegativity of the nitrogen dioxide will induce two distinct responses of the sensor [7].

References

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Figures

Electrochimical Delamination	Oxidative Delamination	Copper Etching
96.10 % ± 1.27	85.45 % ± 2.87	99.47 % ± 0.45

Figure 1: Graphene coverage rate depending on the graphene transfer method

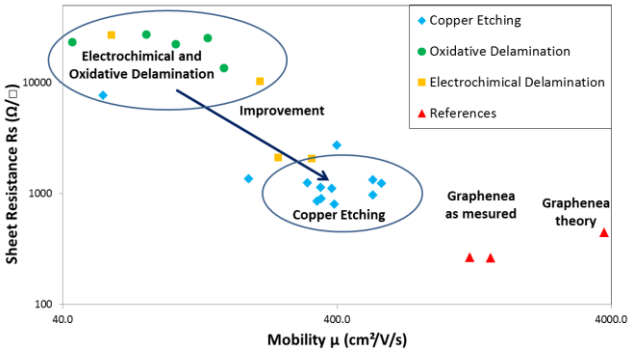

Figure 2: Progression of the electrical properties through (sheet resistance against electronical mobility) the enhancement of the graphene transfer method