CVD-graphene synthesis using different transition metals as catalyst

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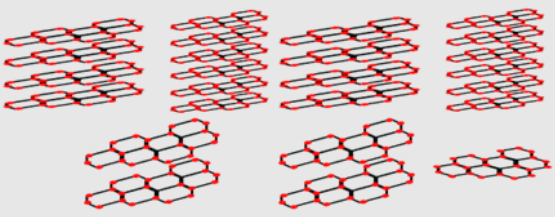
Abstract

Graphene, an extraordinary two-dimensional carbon material with a honeycomb structure, has been the focus of many researches due to its characteristics and extraordinary mechanical, electronic and optical properties. Chemical Vapor Deposition (CVD) method has been shown to produce large-area and high quality graphene. In CVD, Ni and Cu are normally used as substrates, although other transition metals are used, but less usual [1].
The aim of this investigation was to optimize the synthesis of CVD-graphene using polycrystalline Ni and Cu as catalytic substrates. The process optimization was based on minimizing the number of defects on graphene samples while the number of graphene layers was decreased. To improve the CVD-graphene synthesis, the optimization of the following operating variables was carried out: synthesis temperature, CH_4/H_2 flow rate ratio, reaction time and total flow of gases (CH_4+H_2) during the reaction step. To achieve this objective, an Excel-VBA application based on images obtained by Optical Microscopy was designed. This application allows determining the percentage of each type of graphene deposited over the catalytic metal. Thus, depending on such percentage, the software assigns values between 1 and 1000 referring to quantify the thickness of the synthesized graphene. This way, multilayer graphene corresponds with the value of 1, 10 is assigned to few layer graphene, 100 corresponds to bilayer graphene and 1000 is assigned to monolayer graphene. The higher the average value, the lower the thickness of the graphene sheet and thus fewer layers would have the obtained graphene [1, 2]. Finally, Raman spectroscopy was conductive to perform an exhaustive characterization of the synthesized graphene samples [3].

References

[1] Lavin-Lopez, M.P., et al., Physical Chemistry Chemical Physics, **16** (2014) 2962-2970.
[2] Lavin-Lopez, M.P., et al., New Journal of Chemistry, **39 (**2015) 4414-4423.
[3] Das, A., B. Chakraborty, and A.K. Sood, Bulletin of Materials Science **31**(2008) 579-584.

Figures

VARIABLE	COPPER	NICKEL
Reaction temperature	1050	980
CH_4/H_2 Flow rate ratio	0,07	0,07
Total flow (CH_4/H_2)	60	80
Reaction time	10	1
Graphene obtained		
Quality	59	810