N-doping in 3D graphene foams by chemical vapour deposition

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The possibility to realize three dimensional (3D) graphene based architectures, able to strongly increase the high specific surface areas of this challenging material, while maintaining strong mechanical strengths and fast mass and electron transport kinetics, make them very promising in fields like sensing or catalysis [1]. In this contest, dopants like N can be introduced to induce a charge polarization in the carbon lattice, modifying its electronic properties and surface wettability, or to create anchoring sites for chemical reactions often used in organic chemistry to functionalized surfaces, enabling specific reactions and catalysis processes [2,3]. In this work we realize N-doped 3D graphene foams (GF) by chemical vapor deposition on Ni foams used as templates. We used CH_4 and H_2 as gaseous precursors and NH_3 as N-doping source. The synthesis process is widely investigated in order to study the doping process and optimize the N type bonding mechanism. We found that the state in which N rearranges into the graphene lattice strongly depends on the stage of the Chemical Vapour Deposition (CVD) synthesis in which the NH3 is introduced in the reaction chamber. Moreover, if the N doping level is very high, it can affect the lateral growth of the graphene clusters, thus leading to micrometric triangular graphene domains. Morphological characterizations as a function of the CVD process conditions are modelled and their scenario is validated by means of ab-initio calibrated kinetic Monte Carlo simulations. The obtained data are of fundamental importance for a successful application of N-doped GF structures in sensing or catalysis field.

REFERENCES

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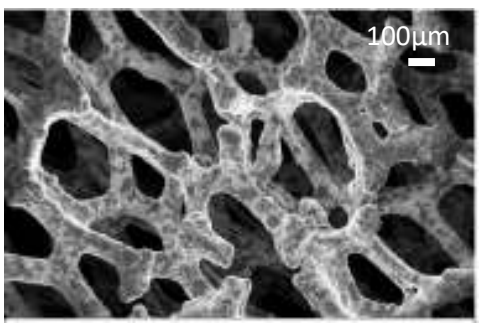

Figure 1: Scanning electron microscopy image of a sample of N-doped graphene grown by CVD on a nickel foam template