Super-hydrophobic graphene-based materials: impact of surface properties on wettability

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Self-cleaning surfaces work via extreme water repellence: water forms spherical droplets which easily roll off the surface removing on their path: dirt, contamination, bacteria, etc.[1,[2] To achieve near spherical water droplets, materials must have textured surfaces (in the micro/nano range), and be hydrophobic (waxy).[1,2] Graphene is naturally hydrophobic, forming ~90^0 contact angles with water; this makes it an excellent candidate for producing super-hydrophobic surfaces. However, real-life graphene materials contain a number of defects within their structures, generated by either synthesis, or the transfer methods.[3] These include vacancies, strained cells, and the presence of functional groups (see Figure 1), and they can increase the surface energy of graphene by creating local permanent dipoles. Therefore, not only chemistry and morphology determine the wettability of graphene surfaces, but also the density of defects.

Due to the broad range of potential applications for super-hydrophobic surfaces, there is a need to better understand how to fabricate them using simple methods, but also how various surface properties, such as morphology, chemistry and roughness affect surface wettability and stability. In this work, we use a top-down deposition method, which is in our view a cost-effective way to produce super-hydrophobic graphene films, and we study how solvent-graphene interactions affects flakes morphologies, and ultimately films morphology and wettability (see Figure 2).

References

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[2] T. Darmanin, F. Guittard, Mat. Today, 18 (2015) 273
[3] S. Park, R. S. Ruoff, Nat. Technol., 4 (2009) 217

Figures

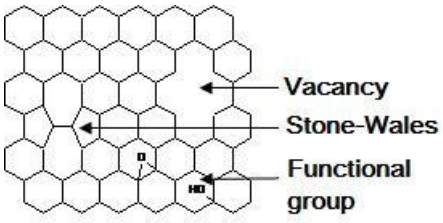

Figure 1: Type of defects present in real-life graphene sheets.

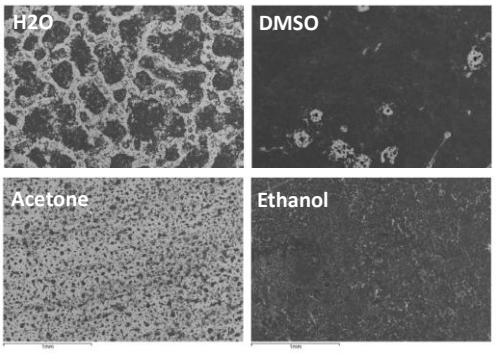

Figure 2: SEM images of graphene films prepared under identical spraying conditions on Si wafers by using dispersions with various solvents, such as water, dimethyl sulfoxide, acetone and ethanol.