Solvent effects control of the wettability behaviour of graphene thin films

Florina Truica-Marasescu[1], Mary Gallerneault[2], Cameron Giglio[2], Osayuki Osazuwa[2], Aristides Docoslis[2]

[1]ALCERECO Inc., Grafoid Global Technology Centre, 945 Princess Street, Kingston, Ontario K7L 0E9
florina.truica@alcereco.com
[2] Department of Chemical Engineering, Queen's University, Kingston, ON K7M 8Y2

Abstract Graphene is naturally hydrophobic, which makes it an excellent candidate for producing super-hydrophobic surfaces. Two factors play important roles for the functionality and the wetting behaviour of super-hydrophobic surfaces: the chemical composition of the material, and the geometric structure of the surfaces.[1] However, as it has a low contact angle (CA) with water droplets, the hydrophobicity of graphene is not enough to exhibit the strong water repellency needed for some practical opportunities, such as fluid transport, self-cleaning, environmental remediation, and energy applications.[2] Two approaches are generally used to improve the wetting behavior of graphene surfaces: (i) creation of surface micro / nano structures by mechanical means, or (ii) the grafting of suitable chemical groups / polymers (e.g. chemical functionalization with F-containing groups).[2,3]
In this work, a different approach was used, namely exploiting solvent-particle interactions in graphene dispersions in order to control surface morphology (and thus wetting behaviour) of the films deposited onto Si wafers. The impact of solvent-graphene platelet interactions on the morphology of the suspended particles, and on the morphology of the resulting graphene films was investigated using appropriate characterization methods, such as: Dynamic Light Scattering (DLS), CA measurements, and Scanning Electron Microscopy (SEM). The dispersant polarity, and the total surface coverage of substrates were studied to develop an understanding of each parameter on the tunability of graphene-based thin films. The study made evident that the physico-chemical properties of the graphene films vary significantly depending upon the treatment of the precursor material, the cleaning/preparation of the substrate surface, and the deposition method.

References

[1] Y. Yoon, D. Kim, J.-B. Lee, Micro and Nano System Lett., **2** (2014) 1.
[2] Z. Chen, L. Dong, D. Yang, H. Lu, Adv. Mater., **25** (2013), 5352.
[3] Y.J. Shin, Y.Y. Wang, H. Huang, G. Kalon, A.T.S. Wee, Z.X. Shen, C.S. Bhatia, H. Yang, Langmuir, **26** (2010), 3798.

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