Department of Materials Science and Engineering Seminar Series 2023

Dimensionality reduction of 2D materials: nanodevices and *in-situ* nanomechanical analysis

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Venue: Zoom Meeting

https://nus-sg.zoom.us/j/83209145516?pwd=YmF4elNDSWVMY3VoYTlZL3VxT3o5UT09
Meeting ID: 832 0914 5516
Passcode: 948649

Abstract

The field of two-dimensional (2D) materials has evolved immensely in the last decades after the isolation of graphene in 2004. With superlative properties and atomic thickness, 2D materials are inherently soft and can undergo morphological changes, such as from nanosheets (2D) to one-dimensional (1D) nanoscrolls arrangements. Unlike multiwall carbon nanotubes (MWCNT), nanoscrolls possess non-concentric and open-ended topological structures with tuneable interlayer distance. These characteristics make nanoscrolls excellent candidates for applications that require relaxation or constriction on demand due to lattice expansion/retraction capability. This thesis is focused on the investigation of nanoscrolls formed under two different circumstances: (i) by means of chemical functionalization to obtain 2D electrolytes, and (ii) after rolling up mechanically exfoliated graphene nanosheets by

solvent intercalation to form high quality graphene nanoscrolls. Firstly, we show a theoretical approach sustained by research experiments to reveal how 2D electrolytes are formed and behave under different environmental conditions. Next, we demonstrate that a thermal annealing procedure can improve the mechanical and electrical properties of nanoscrolls by increasing the structural rigidity and lowering the density of functional groups. Ultimately, we show how that nanofabrication techniques allowed us to produce nanoscroll-based devices and measure their electrical, mechanical and electromechanical properties. We believe our results contribute to the development of structural reinforcement or conductive fillers in composite materials, thin film technologies, nanoelectromechanical systems (NEMS), and energy storage devices based on nanomaterials with 1D geometry.

Biography

Mariana Costa received her B.Sc. and M.Sc. degrees in Materials Engineering and Nanotechnology from Mackenzie Presbyterian University in Brazil. She is currently a Ph.D. candidate in MSE department at NUS under the guidance of Prof. Sir Konstantin Sergeevich Novoselov. Her research is focused on the development of functional intelligent materials (FIMs) and manufacturing of devices for measuring the electrical, mechanical, and electromechanical properties envisioning their application into nanomechanical systems.

Please join us!
HOST: A/Prof. Xue Junmin