S. N. Bose National Centre for Basic Sciences

Celebrating 2018 BOSE 125th Birth Anniversary

Bose Colloquium

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Speaker

Prof. Alok K. Ray

Project Leader, RISP, Beam Technology Development Group,
Bhabha Atomic Research Centre, Mumbai &
Senior Professor, Homi Bhabha National Institute

Title

Functionalized graphene - highly effective multipurpose smart materials

Abstract

Graphene composites offer many of the stringent demand for their consideration as synergistic multifunctionalized materials. Among others a few recent applications of graphene materials are directed towards flame retardant supercapacitor, oil/organic solvent sorbent in sea water, transparent fire retardant coating on fabrics, etc. For example, phosphorus functionalised graphene quantum dot (PfGQD) material is found to exhibit transparency as well as efficient flame retardant properties. Flame retardant (FR) efficiency of the PfGQD coated fabrics and PVC cables was verified by detail flame tests such as limiting oxygen index (LOI), exposure to high heat flux (~50 kW/cm^2) and turbulent premixed flame at high temperature (~14000 C).

In contrast, co-functionalization of phosphorous and nitrogen groups on the 3-D structure of graphene helps to generate a multitasking ultra-light 3-D functionalized spongy graphene (3D-FSG), which offers an efficient flame retardant effect as well as an excellent electrochemical characteristics for super-capacitor applications. Further, 3D-FSG material accomplishes efficient adsorption and removal of intermingled spurious oil and organic solvents in sea water. Adsorption tests revealed that FSG has significantly high oil and organic solvent sorption capacity in the range of 40-90 g/g. More importantly, the FSG material can be reused for minimum 10 cycles. Flame test of the FSG revealed that it is able to sustain flame retardancy at temperature as high as 1500° C for a continuous exposure of ~ 5 min. For symmetric capacitor application, it was found that the grapheme sponge possesses a maximum specific capacitance of 494 F g^{-1} at a current density of 1A-g^{-1}. These findings open the new window for smart multi-tasking 3-D ultra-light graphene spongy materials.

The talk will focus on realization of functionalized graphene materials and their characterization by various spectroscopy techniques and scope of its applications for flame retardant fabrics, supercapacitors in automobiles and sorbent for spilled oil in sea water.