Enhanced Thermal Conductivity Measurement In 2D Boron Nitride Infused Plastic By Employing Raman spectroscopy

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The increasing interest in the hexagonal boron nitride (h-BN) is validated due to its exceptional properties such as high thermal conductivity, better chemical stability, higher mechanical strength and structural stability [1]. With decreasing thickness of bulk h-BN, the phonon-phonon scattering is reduced, leading to a thermal conductivity as high as 400 W/mK for a single layer of boron nitride nanosheet (BNNs). Using such 2D nanosheets as nano fillers in polymers or any host material that require better thermal management is an obvious application for many industries, particularly the polymer industry [2]. To realize such an application at industrial level, the challenging task is to synthesize 2D nanosheets in large scale. We have been able to synthesize BNNs in large quantities by a novel opto-mechanical method [3]. The exfoliated BNNs were dispersed into polyethylene terephthalate (PET) polymer. Thermal conductivity of PET:BN nanocomposite was studied as a function of filler percentage (wt.%) in the PET matrix. Before studying the thermal conductivity, the structural properties of the nanocomposite films were studied employing SEM, DSC and Raman spectroscopy. The thermal conductivity measured by the non-destructive optical method (Raman spectroscopy) [4], shows that the thermal conductivity of PET:BN nanocomposite film increases by almost a factor of two over a filler infusion of 0.5 wt.%. Figure 1 shows cross-sectional SEM image of PET:BN composite and the plot of thermal conductivity as a function of BNNs infusion concentration.

References

[1] Xidong Duan et. al, Chemical Society Review, 44(24) (2015), 8859
[2] Chunyi Zhi et. al, Advanced Materials, 21 (2009), 2889
[3] Arindam Ghosh and Gayathri H N, Patent under review
[4] B Stoib et. al, Semiconductor Science and Technology, 29 (2014) 124005

Figures

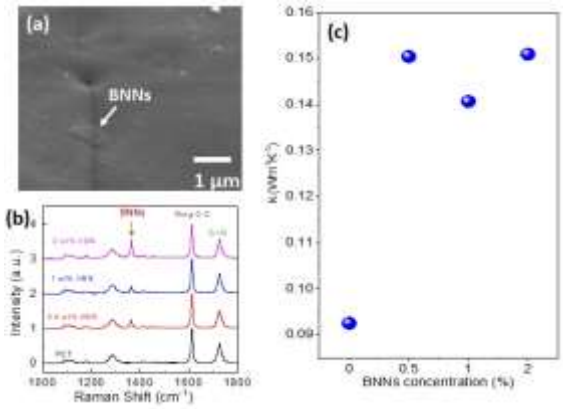

Figure 1: (a) Cross-sectional SEM image of a typical PET:BN composite film. (c) Raman signatures for various PET:BN nanocomposite films. (d) Thermal conductivity as a function of BNNs filler concentration.