Influence of dispersion state of graphene on percolation threshold of conductive graphene/polymer nanocomposites.

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The large variation in the reported percolation threshold values of graphene-based nanocomposites which ranges from 0.1 to greater than 2 wt% indicates that the dispersion states and other properties of graphene affected by processing conditions are important in determining the electrical properties of graphene/polymer nanocomposites. For nanofiller/polymer nanocomposites dispersion state of a nanofiller was recognized as one of the critical factors governing conductivity of composites as well as physical properties. It is generally accepted that a good filler dispersion within the polymer matrix enhances the physical properties of the composite. However, a few studies done on carbon nanotubes/polymer nanocomposites suggest that agglomeration of the nanotubes could favor the formation of a percolating network [1,2]. In this work dispersion state of graphene as parameter having influence on percolation threshold of corresponding composites prepared with latex technology [3] is discussed.

Graphene dispersions of different degree of exfoliation and stability were prepared with the aid of sonication. The dispersion process was monitored by measuring UV–Vis absorption. Quality of the nanofiller was characterized by Raman spectroscopy. The conductivities of the final composites were measured by a four-point method. The organization of graphene sheets in nanocomposites and their conductivity distribution was analyzed with nanometer resolution by means of conductive atomic force microscopy (C-AFM). The results indicate that agglomeration of graphene sheets and clustering formation can significantly decrease a percolation threshold of the nanocomposites.

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References

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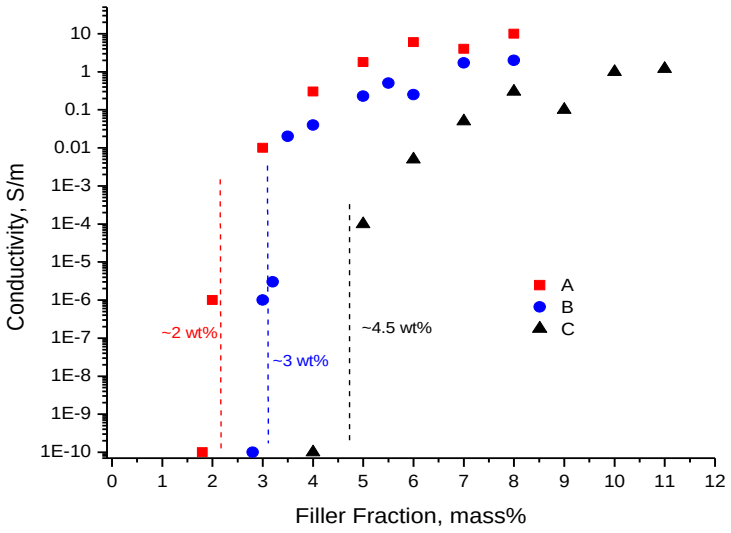

Figure 1. *Conductivity profile for composites prepared with graphene dispersions of different stability. Stability of the dispersions is increasing in the range A<B<C.*

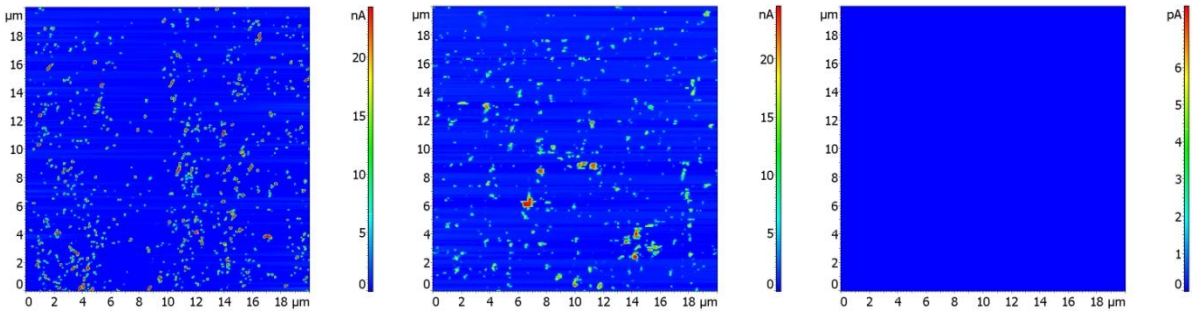

Figure 2. *C-AFM images of graphene/polymer nanocomposites containing 4 wt% of graphene prepared with dispersions A, B and C respectively.*