Electrical conductivity of carbon nanopowders.

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The discovery of graphitic nanoparticles with exceptional electrical transport properties, like high conductivity and high charge mobility, has incredibly broadened the range of potential applications of this class of materials, thus unleashing a revolution in electronic devices industry. Two of the most important members of this new generation of materials are undoubtedly carbon nanotubes and graphene. Perhaps the biggest challenge to be faced is how to manipulate these nanoparticles in order to bring effectively their remarkable electrical properties onto the macroscopic level. Since the conductive performance of the composites is directly related to the formation of a conductive network through the polymer matrix, its understanding depends, at least partly, on the knowledge of the electrical behavior of the nanoparticles agglomerates, here called bulk powder.

The electrical conductive behavior of different carbon materials (multi-walled carbon nanotubes, graphene, carbon black and graphite), widely used as fillers in polymeric matrices, was studied using compacts produced by the buckypaper preparation process and powder compression [1-7]. Powder pressing assays show that the bulk conductivity depends not only on the intrinsic material properties but is also strongly affected by the number of particle contacts and the packing density. For nanotube, graphene and graphite particles, the conductive behavior during compaction is governed by mechanical particle arrangement/deformation mechanisms. The buckypaper preparation process induces a high in-plane preferred orientation for the large surface area nanotube and graphene particles, thereby yielding largely the single particle intrinsic conductivity for the in-plane direction. The relevance of the results for composite processing is discussed.

References

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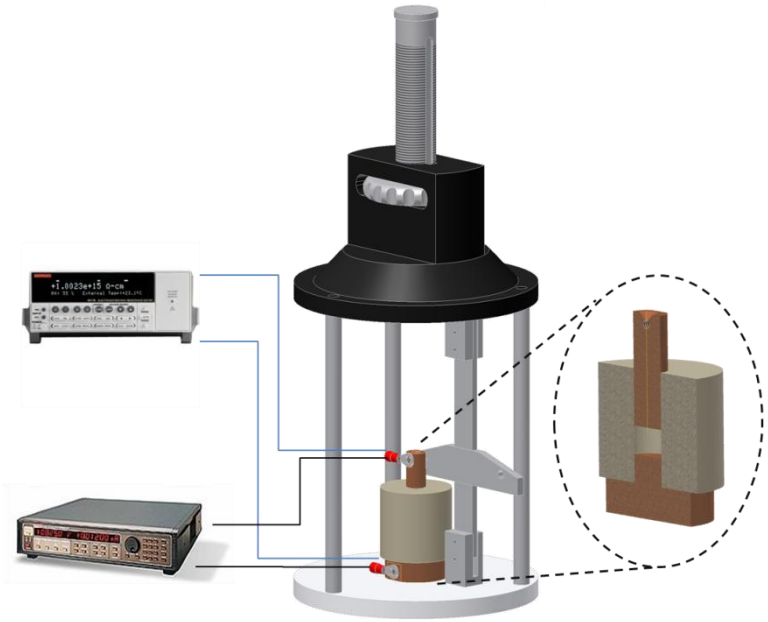

Figure 1. *Schematic representation of the experimental set-up involved in the measurement of the powder conductivity.*

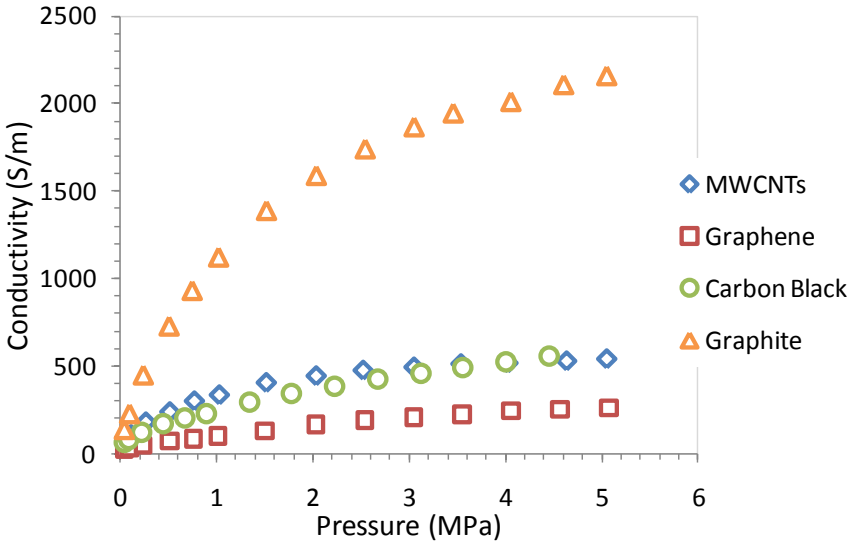

Figure 2. *Electrical conductivity behavior of the different carbon powders as a function of pressure. For each material the data points represent an average of at least 3 identical assays differing not more than 3%..*