All-Carbon supra-structures: fullerene decorated carbon nanotubes

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Random 3D- networks of carbon nanotubes (CNT) decorated by fullerene crystallites or coated by an amorphous layer of C_{60} molecules are an example of carbon-based electronic materials that may combine the geometrical, electrical and mechanical properties of the two carbonaceous nano-structures. Unlike covalently linked CNT- fullerene hybrids where the chemical and physical properties of the carbonaceous nanostructures are significantly modified, n*on- covalent,* Van-der-Waals(vdW)-type hybrids are expected to preserve the intrinsic properties of the components [1],[2]: the efficient electron transport properties of pristine CNT (electron mobility of 10,000 cm2 V^{-1} s^{-1} for SWNT) and the ultrafast photo-induced electron acceptor behaviour of C_{60} along with the strong singlet oxygen sensitising ability and may exhibit non-linear optical activity. We report the preparation and characterization of hybrids comprising 3D (random) networks of CNT decorated by fullerene crystallites, formed via vapour deposition. Thermal reorganization of the hybrids results in CNT-C_{60} core-shell like structures. Electron imaging, electron diffraction and Raman scattering enable structural characterization of the *fcc* C_{60} crystallites and their re-organization into an amorphous shell onto the CNT network. Electrical conductivity measurements of the hybrids suggest that the fullerenes improve CNT-CNT contacts enabling the preparation of transparent-and –conductive networks that can be used as components in organic photovoltaics and printed electronics.

References

[1] Svec M, Merino P, Dappe YJ, Gonzalez C, Abad E, Jelinek P, Martin-Gago JA, Phys Rev B 86 (2012) 121407.
[2] Yekymov E, Bounioux C, Itzhak-Cohen R, Zeiri L, Shahnazaryan E, Katz EA, Yerushalmi-Rozen R J Energy Chem (2018) 27(4):957.

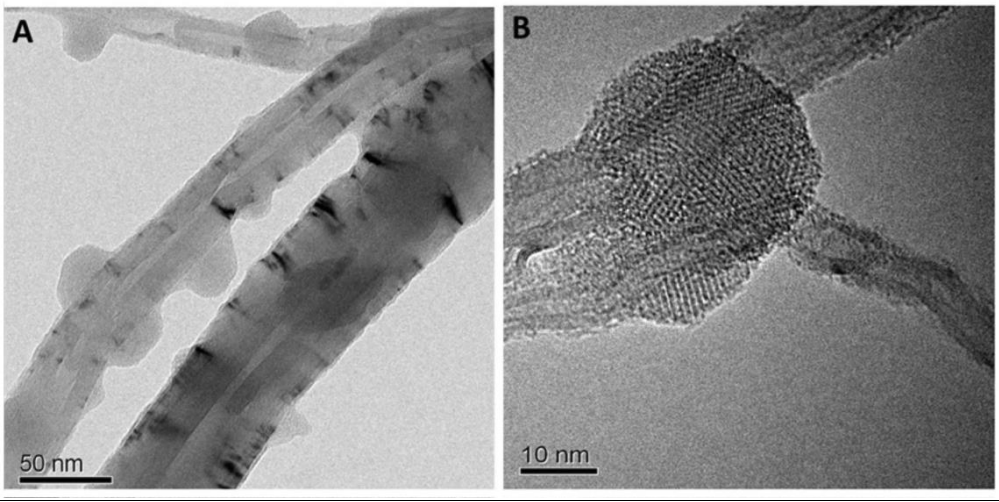

Figure 1: TEM images of as-prepared C60–MWNTs hybrids at C60 (deposition rate of 0.2 Å/s) substrate temperature 25 °C (a, b) and 150 °C (c, d)