Synthesis of graphene nanoribbons from carbon nanotubes

Eunice Cunha[1], M. Conceição Paiva[1], M. Fernanda Proença[2], Manuel Melle-Franco[3], Florinda Costa[4], António J. Fernandes[4],

[1] Instituto de Polímeros e Compósitos/I3N, Universidade do Minho, Campus de Azurém, 4800-058 Guimarães, Portugal
[2] Departamento de Química, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

[3] Centro de Ciências e Tecnologias de Computação, Universidade do Minho, Campus de Gualtar, 4710-057 Braga, Portugal

[4] FSCOSD/I3N, Universidade de Aveiro, Campus Universitário de Santiago, 3810-193 Aveiro

mcpaiva@dep.uminho.pt

Abstract

The process proposed induces the unzipping of carbon nanotubes (CNT) that were previously functionalized using a cycloaddition reaction route. The graphene nanoribbons (GNR) formed are expected to present interesting properties, depending on their width and on their edge shape [1]. This synthesis route for GNR was based on the observation of unzipping of the functionalized CNT under STM conditions [2].

The GNR synthesis was carried out in solution, forming functionalized GNR. CNT with a range of different diameters were functionalized using the 1,3-dipolar cycloaddition reaction [3], binding pyrrolidine-type groups to the CNT surface. The solutions containing the nanotube unzipping products were characterized by UV-visible spectroscopy and Raman spectroscopy. The formation of stacks of nanoribbons was observed by transmission electron microscopy (TEM). The wider ribbons, produced from the larger diameter nanotubes, yielded regular stacks with an interlayer spacing of approximately 0.50 nm. Molecular modeling was applied to study the crystalline stacking of pyrrolidine functionalized GNRs yielding interlayer distances of 0.51 nm, in agreement with TEM observation. Figure 1 presents TEM images of the wider nanoribbons and the unit cell for the model representing the stacking of functionalized graphene.

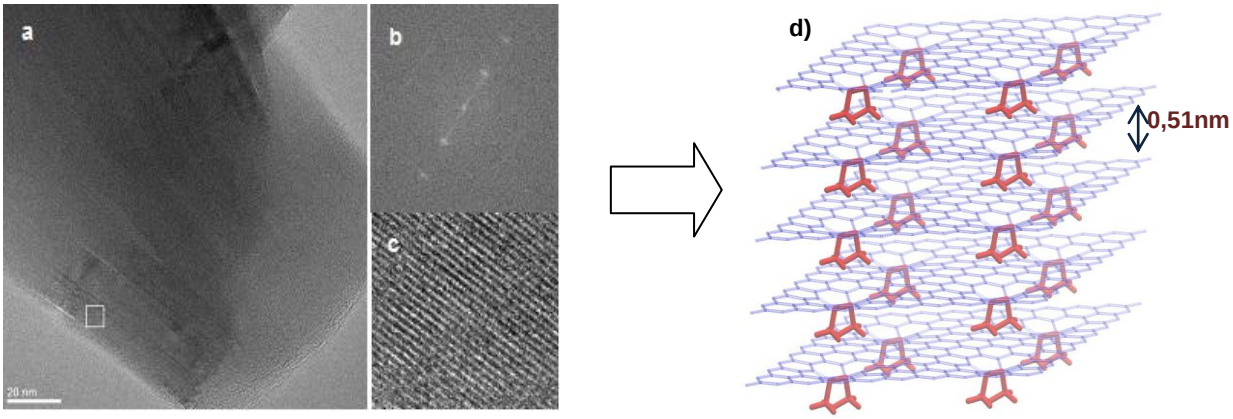

Figure 1. TEM micrograph of GNR formed in ethanol by unzipping of MW SA, (a); FFT performed on the area within the square frame in micrograph a) (b); magnification of the image area in the square frame in micrograph a), showing the regular pattern (c); unit cell for the model representing the stacking of functionalized graphene (d)

References

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