Strategies of Graphene Quantum Dots synthesis and application of quantum dots/graphene nanoribbons hybrid materials as electrochemical sensors

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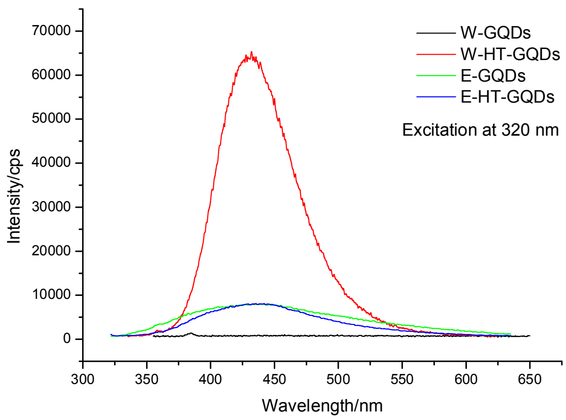
Abstract

Graphene quantum dots, GQDs, have been synthesized using two strategies: electrochemical (E) and wet chemical (W) methods. A simple, industrially up-scalable, two-electrode electrochemical setup, starting from graphite and a one-pot wet chemical synthesis, modified from reference [1] were used to produce GQDs. Filtration, centrifugation, concentration and dialysis were used to purify the obtained products. All GQDs were subsequently submitted to a hydrothermal (HT) process. Photoluminescence properties improved by HT, quantum yield percentage was the best for W-HT-GQDs (8.54%) followed by the E-GQDs, whose photo luminescent properties did not change by HT treatment (~1%). XPS and elemental analysis showed higher number of heteroatoms different from C and O (N, S, Mn) for W-GQDs than for E-GQDs. Figure 1 shows the fluorescence spectra of samples before and after HT treatment and AFM image of sample E-GQD after ultrafiltration through a 20KD membrane. A preliminary electrochemical characterization of their applications as electrochemical sensors in combination with graphene nanoribbons, GNRs, showed that GQDs/GNR hybrid materials offered better current for ascorbic acid oxidation than GNRs alone. These hybrids nanomaterials reduced the capacitive current, thus decreasing the noise/signal ratio, allowing simultaneous detection of dopamine and uric acid, and so improving the intrinsically good properties of GNRs as electrochemical sensors [2]. 1/1 E-GQDs/GNR hybrid showed the best properties in this application..

References

[1] Y. Sun, S. Wang, C. Li, P. Luo, L. Tao, Y. Wei, G. Shi, Physical Chemistry Chemical Physics 15 (2013) 9907.

[2] A. Martin, J. Hernandez, L. Vazquez, M.T. Martinez, A. Escarpa, RSC Advances 4 (2014) 132.



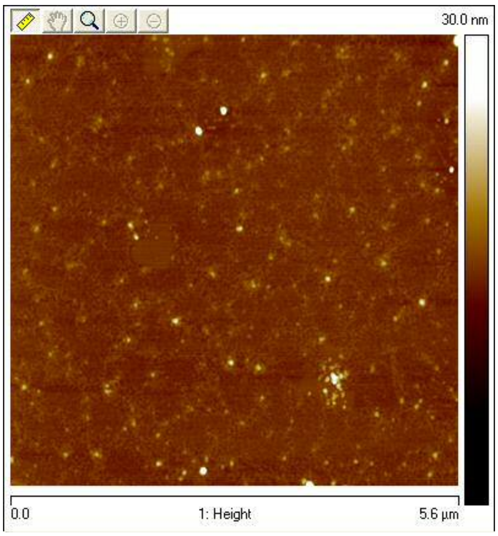


Figure 1.- Left, fluorescence spectra of the samples before and after hydrothermal process, right AFM image of sample E-GQD