New Approach to Synthesize Graphene Quantum Dots

Graphene quantum dots (GQDs), with their excellent properties of graphene, quantum confinement and bounder effect, are attracting more and more attention from scientists all over the world. However, controllable preparation of GQDs with uniform particle size and strong dispersity is still a big challenge. Recently, researchers from the Xinjiang Technical Institute of Physics and Chemistry (XTIPC), Chinese Academy of Sciences have developed a novel top-down approach to synthesize a high-yield preparation of GQDs.

Using a pre-made carbon replica (C/SBA-15) of SBA-15 as a nano-reactor and HNO_3 vapor cutting strategy, the researchers synthesized a high-yield (48%) preparation and a facile separation of yellow-luminescent GQDs. They found that the as-prepared C/SBA-15 containing ordered mesopores may be used as the promising raw material for the preparation of GQDs with controllable sizes, due to its confined mesoporous structures and filling graphitic carbons. The obtained GQDs containing abundant oxygen-containing groups (ca. 30% for oxygen content) showed a narrow size distribution (2.5-5.2 nm), good water solubility, good photostability and high selectivity for Fe(III) sensing in tap water with satisfying recovery.

Inspired by the external oxygen-containing groups of the GQDs, the scientists also investigated their application as fluorescent probes for Fe(III) determination in tap water based on a calibration curve of Fe(III) standards of different concentrations. However, the results of Fe(III) determination showed that the obtained GQDs exhibited a high selectivity towards Fe(III), with satisfying recoveries ranging from 94.3% to 106%.

Based on these experiments, it indicated that Cu(II), Co(II), Mn(II), Ni(II) could also quench the fluorescence of the as-prepared GQD after its surface states being adjusted, which might presage more possible applications of this material.

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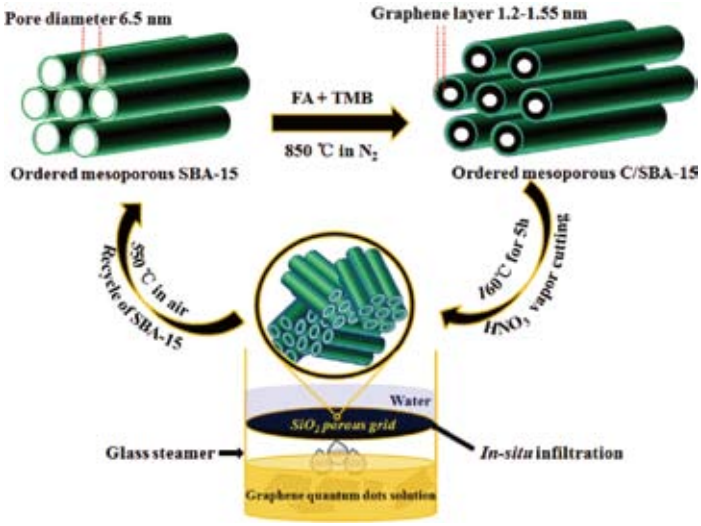
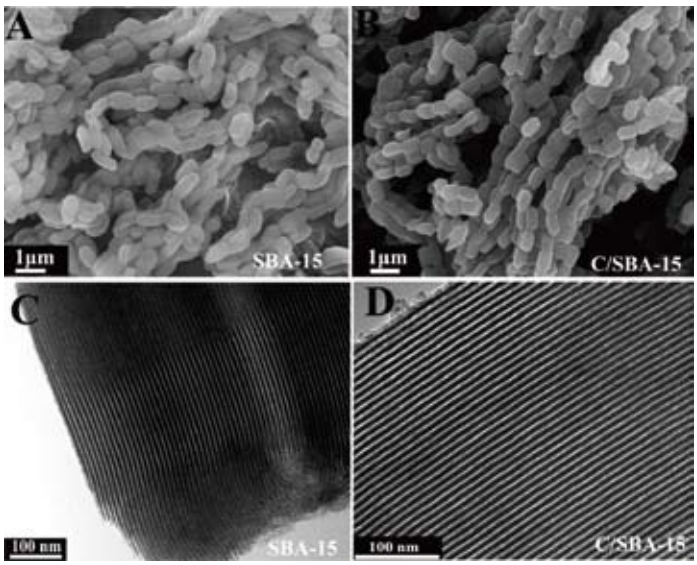


Schematic diagram of the preparation of GQDs.



SEM and TEM images of SBA-15 template (A and C) and its carbon replica C/SBA-15 (B and D), representing the ordered mesoporous structure of the C/SBA-15 composite that derived from the SBA-15 template.