A Facile One-step Method to Produce Graphene–CdS Quantum Dot Nanocomposites as Promising Optoelectronic Materials

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Introduction

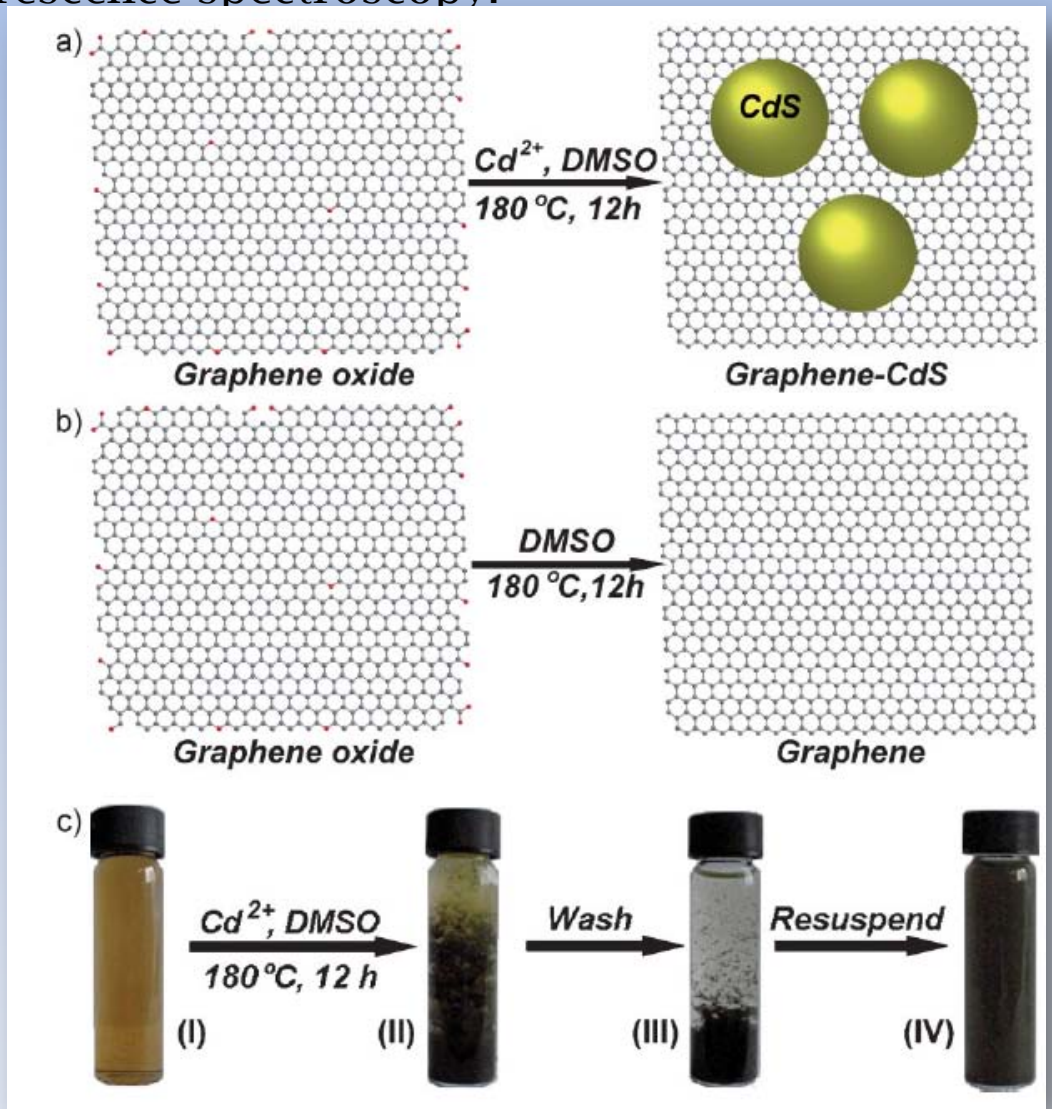
- Assembly of semiconductor nanoparticles, such as quantum dots (QDs), on matrices: optoelectronic applications.
- Electron transport between matrices and QDs.
- Enhancing the photocurrent of semiconductor–matrices systems :

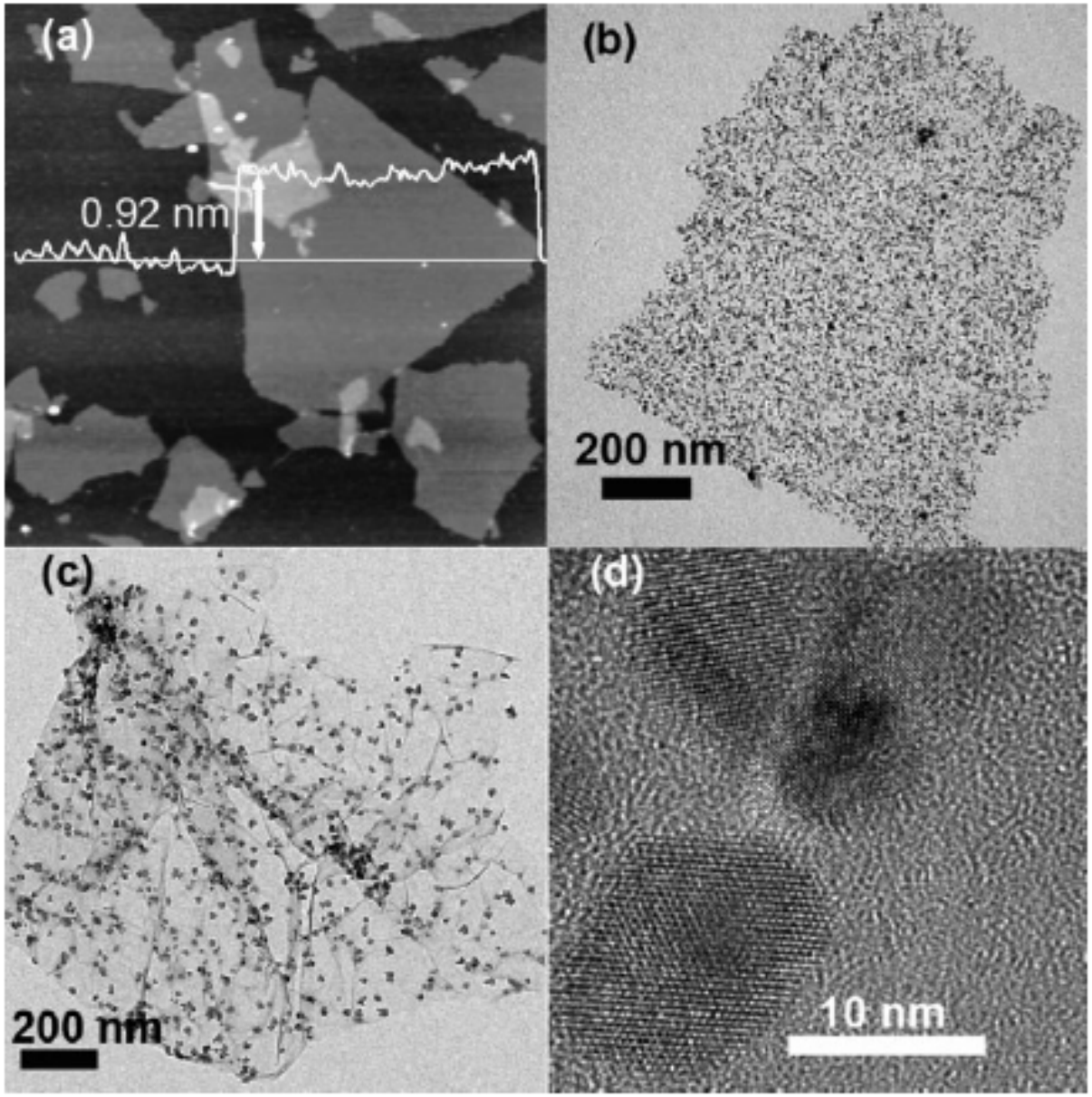
  a)retard the recombination of electron-hole species in the semiconductors by molecular electron-relay semiconductor structures.

  b) Efficient electron-transport matrices such as conductive polymer films or carbon nanotubes (CNTs)
- Atom-thin 2D feature of graphene: excellent electron-transport matrix.

In this paper ……

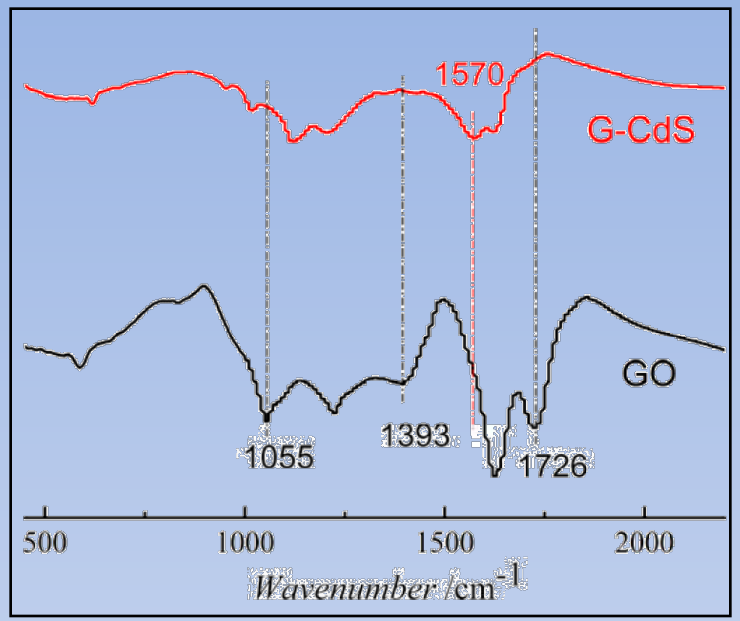
Synthesis of a graphene–CdS quantum dot (G-CdS) nanocomposite that shows promising optoelectronic properties. A picosecond ultrafast electron transfer process from the excited CdS QDs to the graphene matrix has been observed by time-resolved fluorescence spectroscopy.



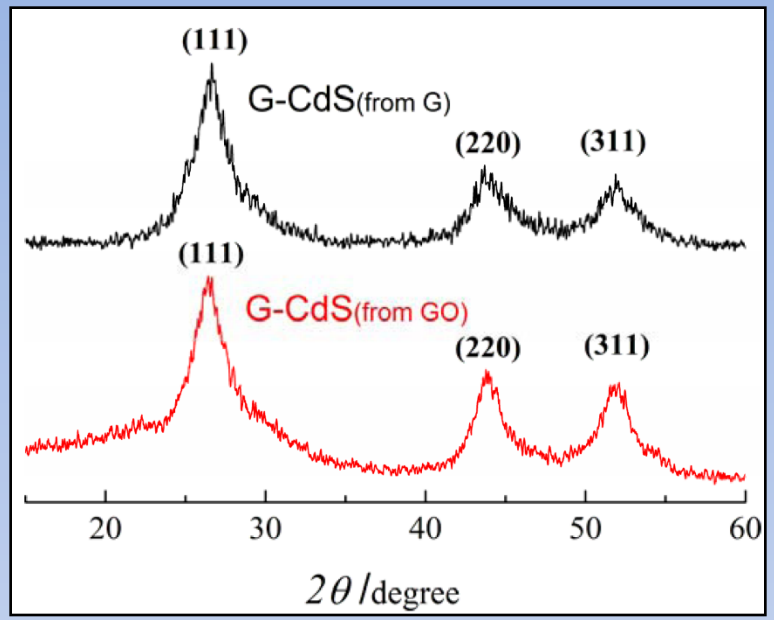


a) AFM image, b-c) TEM image of a G-CdS sheet and d) High-resolution TEM image of CdS crystals on a graphene sheet.

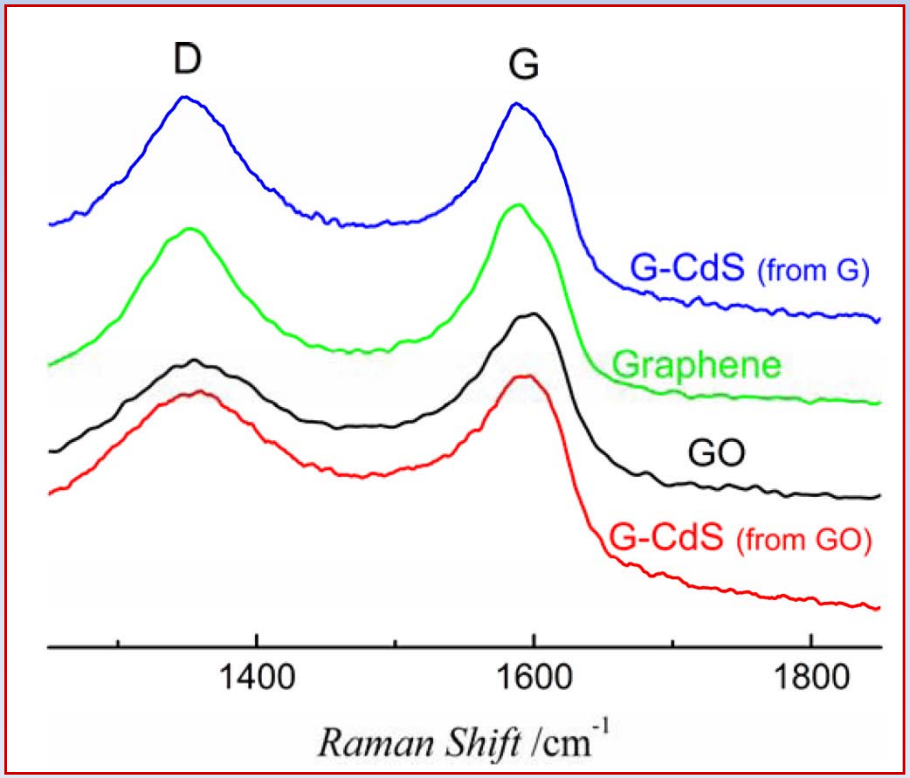
FTIR



XRD

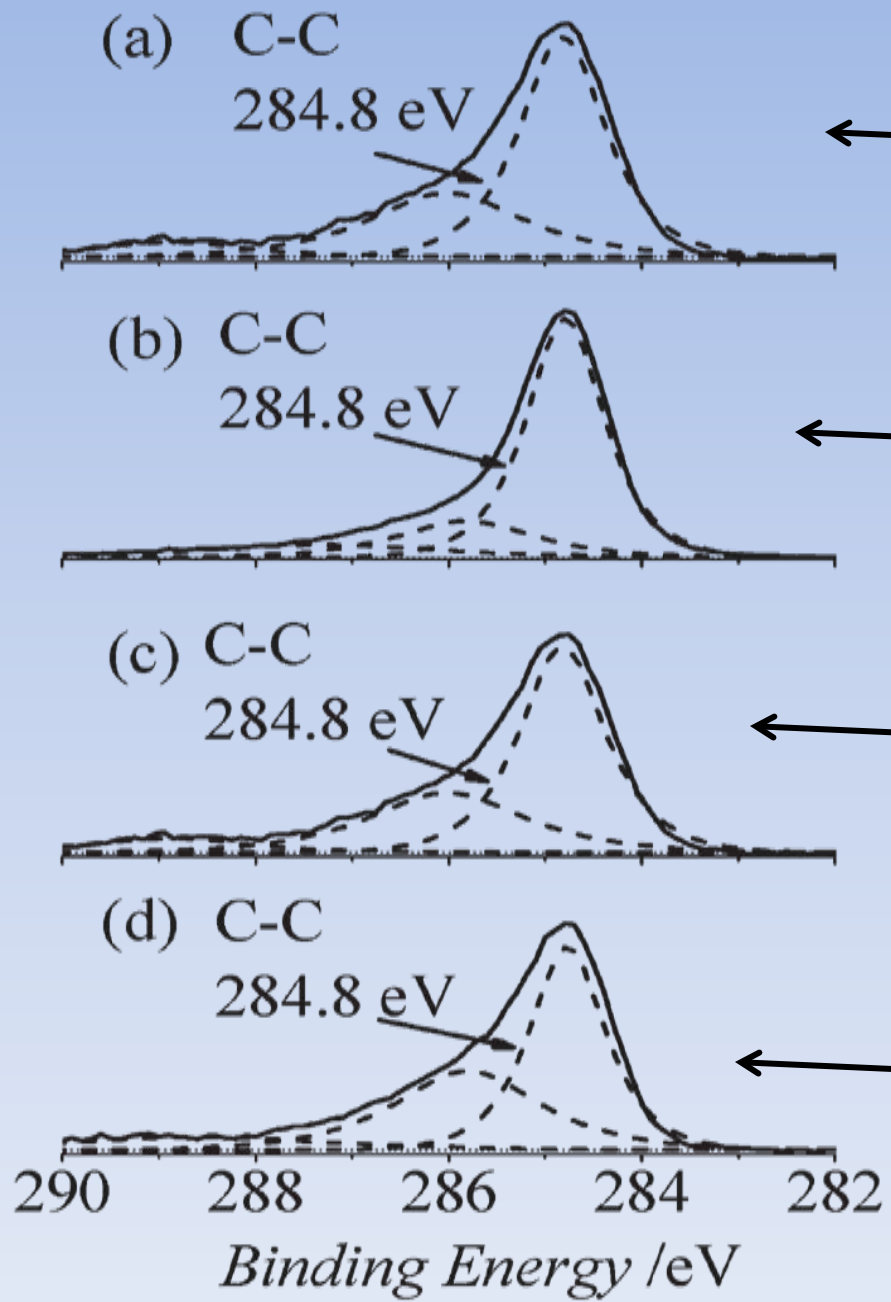


Raman spectra



Hydrazine-reduced graphene (G)

XPS spectra of the C 1s peaks

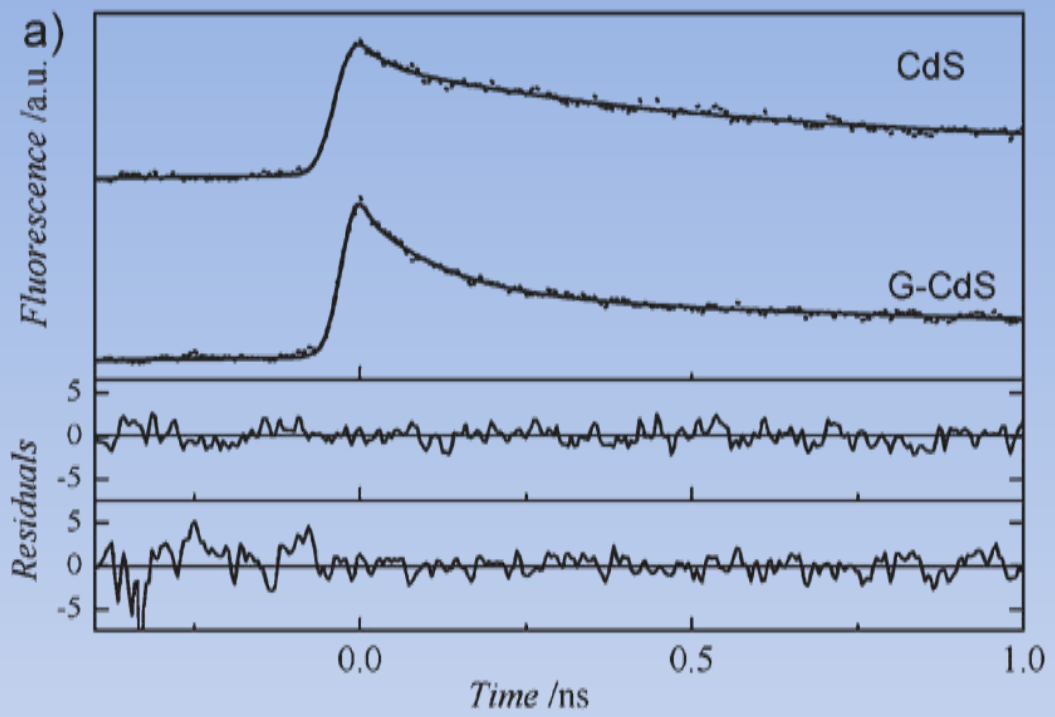


a) DMSO-reduced graphene

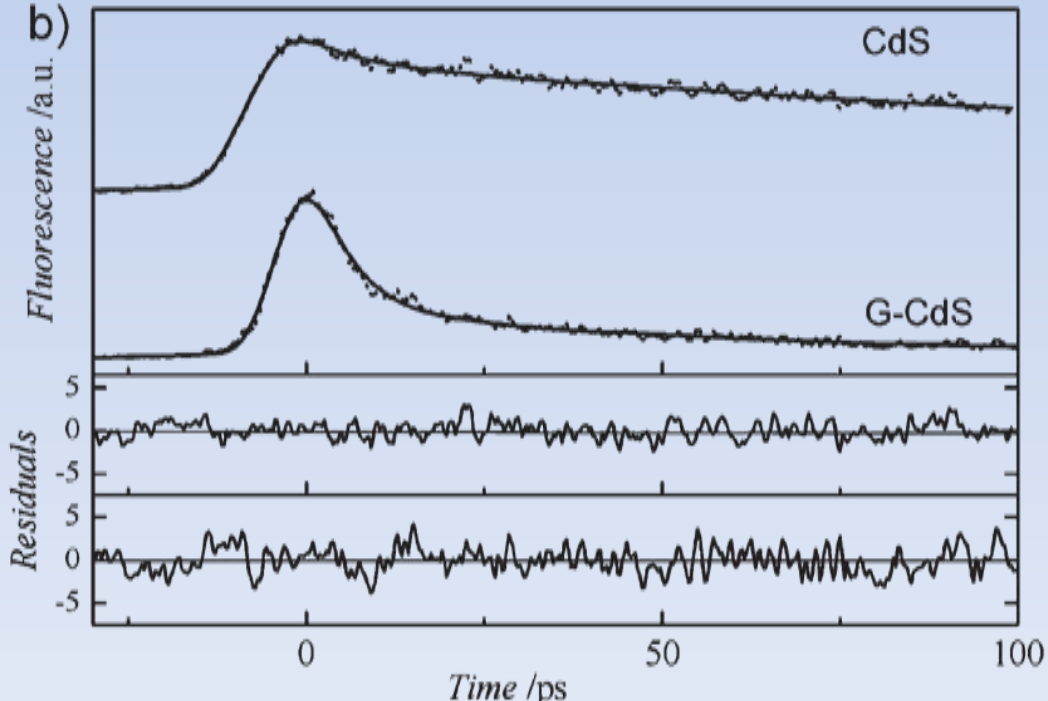
b) Hydrazine-reduced graphene

c) G-CdS synthesized directly from GO

d) G-CdS synthesized from hydrazine-reduced graphene



2.2 ns scanning range with an instrument response functions (IRF) of 16 ps



160 ps scanning range with an IRF of 4 ps

Conclusions

- G-CdS nanocomposite material with good structural and optoelectronic properties has been successfully and directly synthesized from GO by a facile one-step reaction.
- XPS, FTIR, and Raman measurements evidence that GO has been simultaneously reduced to graphene during the deposition of CdS.
- A picoseconds ultrafast electron transfer process from the excited CdS to the graphene sheet has been detected by time-resolved fluorescence spectroscopy
- In comparison with CNTs, the large 2D flexible atom-thin layer of graphene makes it easier to control the distribution of CdS on the graphene sheet and fabricate future optoelectronic devices

- GRP as a matrix
- Better hybrid materials with our systems (QDs)