A Detailed TEM Study of Carbon Nano-Onions’ Structure

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Introduction

Carbon Nano-Onions (CNOs)
- Polyhedral carbon nanoshells
- Fabrication by graphitization
- Applications include lubrication, catalyst support, conductive filler

Transmission Electron Microscopy (TEM)
- TEM analyses provide crystalline structure and carbon bonding information
- Techniques include:
  - Bright-field & Dark-field imaging
  - Selected area electron diffraction (SAED)
  - Electron energy loss spectroscopy (EELS)
- We expand these using image analysis algorithms to quantify crystallite parameters evident in bright field imaging, and by tomography, for morphology and dimensionality

Bright and Dark Field

Transmission Electron Microscopy (TEM)
- TEM analyses provide crystalline structure and carbon bonding information

SAED

SAED pattern of CNOs, the pattern shows diffraction rings corresponding to graphite (002), (100), (004), and (110) layer planes, respectively.

Tomography

Tomography confirms 3D nature of this novel carbon morphology

EELS

Conclusions

- Bright field images show ordered lamella
- SAED “spotty” pattern demonstrates well developed crystal structure (along with lattice structure)
- Dark field shows that structure is spatially localized
- EELS indicates bonding is predominantly sp²
- Image analysis algorithms permit quantification of crystallite parameters
- Tomography confirms 3D nature of this novel carbon morphology

References

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Image analysis algorithms permit quantification of crystallite parameters evident in bright field imaging, and by tomography, for morphology and dimensionality.