

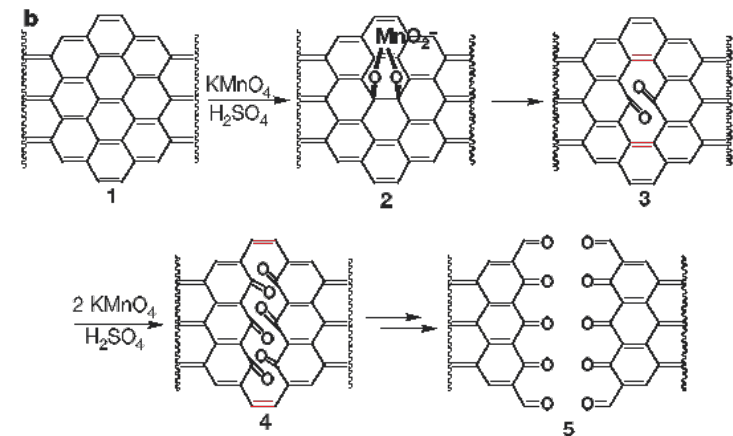
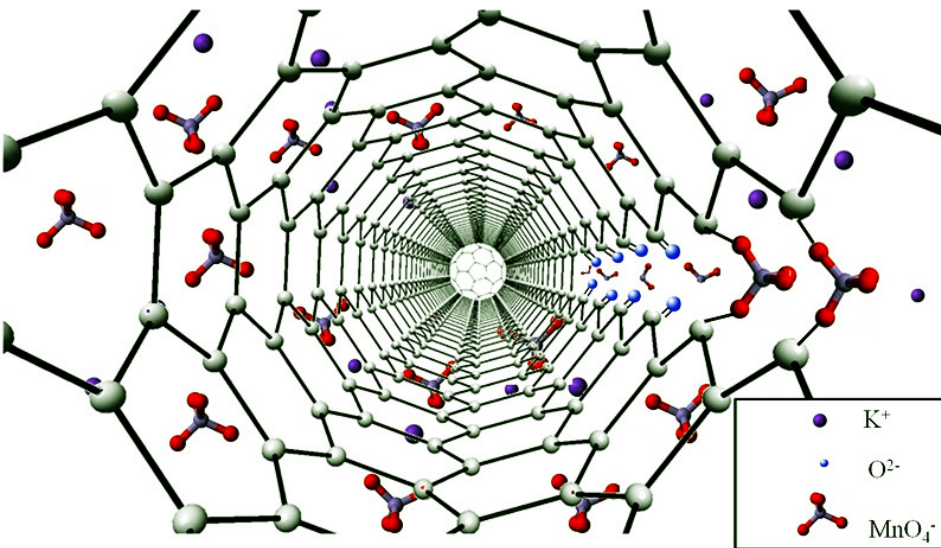
**Graphene Nanoribbons Derived
from
Unzipping of Carbon Nanotubes:
A Top-Down Approach and The
Lithium Ion Battery Performance**

Biwei Xiao

Objectives

- To unzip carbon nanotubes to graphene nanoribbons
- To investigate the effect of defect, surface area and functional groups on lithium ion battery performance

Methodology



Using STXM to study the valence state distribution of Mn to understand the mechanism?

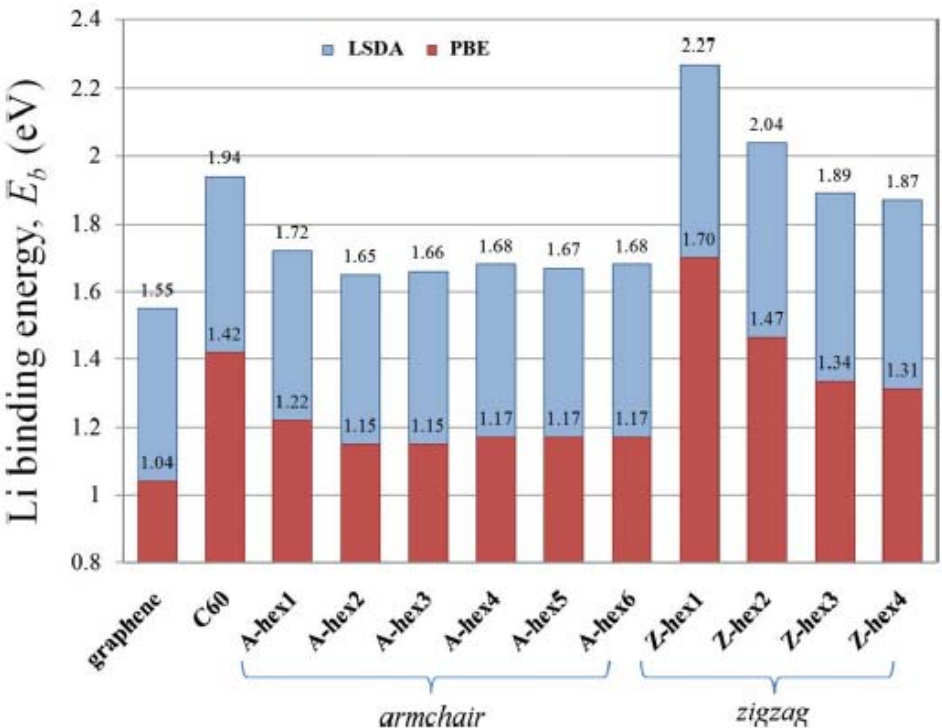
Motivations? In the case of lithium storage

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- Graphene nanosheets
- Armchair graphene nanoribbons
- Zigzag graphene nanoribbons

Lithium adsorption on zigzag graphene nanoribbons

Chananate Uthaisar, Veronica Barone,^{a)} and Juan E. Peralta
 Department of Physics, Central Michigan University, Mount Pleasant, MI 48859, USA

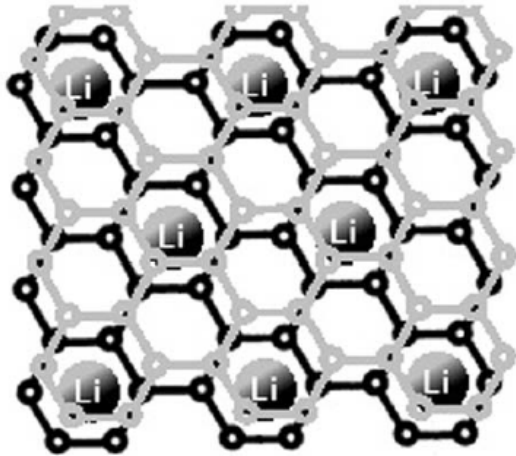


Two functions were utilized to calculate the binding energy of Li⁺ with graphene/nanoribbons, the strength is *Zigzag graphene > Armchair graphene > Graphene*

Beyond theoretical calculations:
Higher surface area for Li⁺ storage than MWCNTs;
Better 3D network than graphene;
More frequently occurred defect sites to accommodate Li⁺

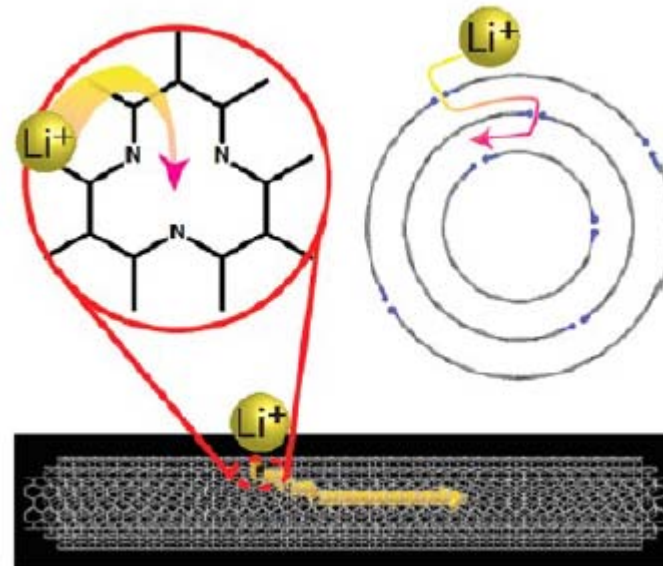
Carbon based materials as anode for lithium ion batteries

- Amorphous carbon
- Graphite
- Carbon nanotubes
- Graphene
- Composites of the above



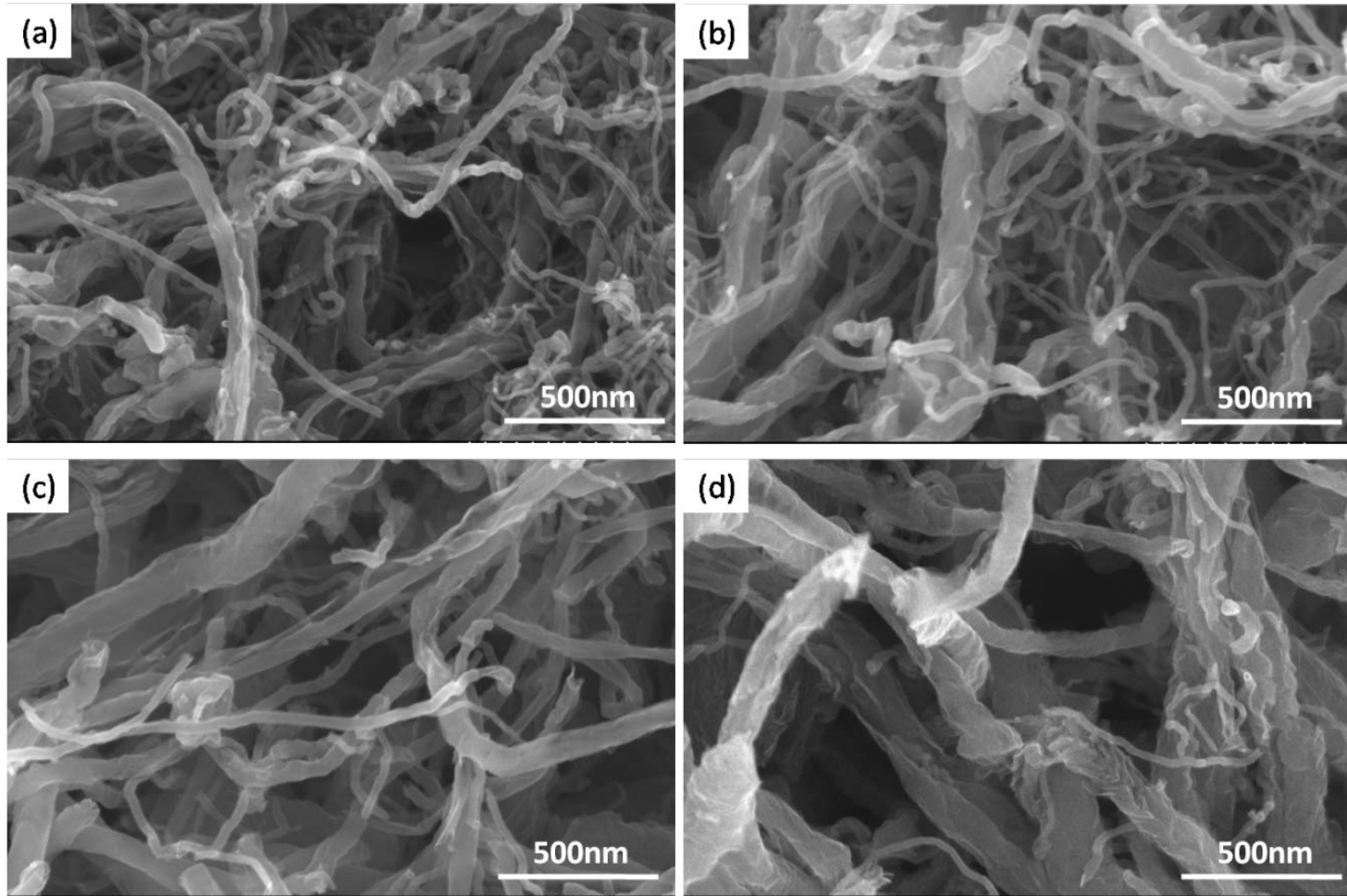
Factors that affect carbon materials performance

- Surface area
- Defect amount
- Surface functional groups



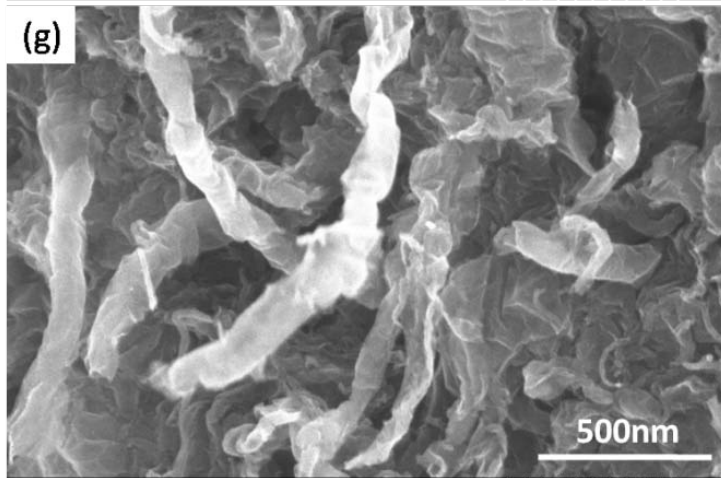
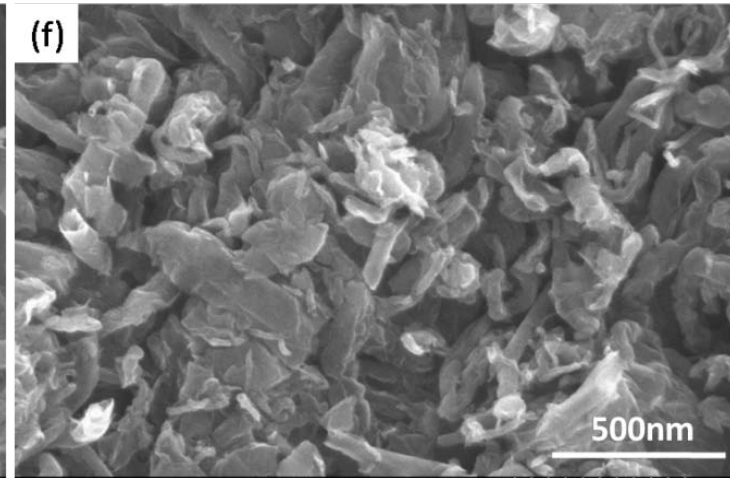
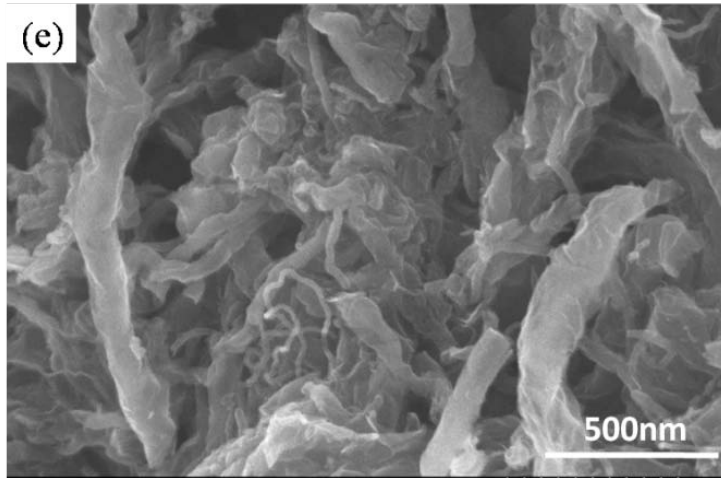
Results and discussion *Morphology evolution*

a: 5min; b: 30min; c: 1h; d: 2.5h;

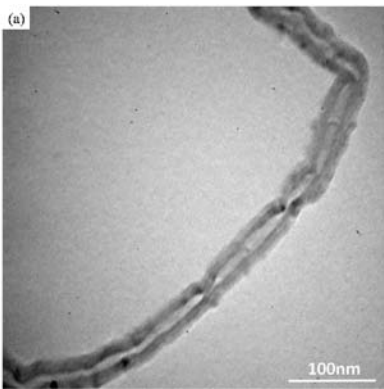


Results and discussion *Morphology evolution*

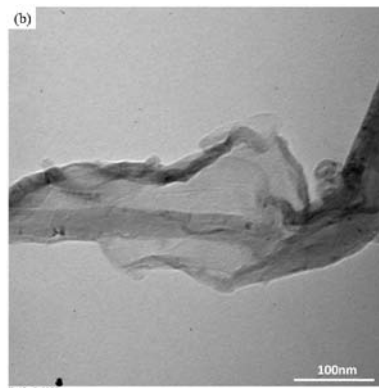
e: 5h; f: 10h; g: 20h;



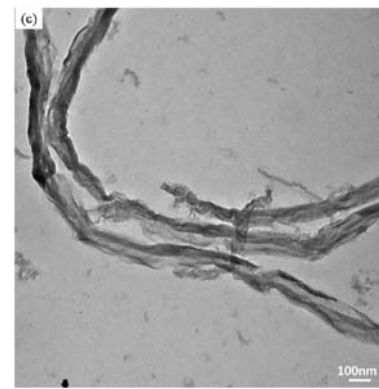
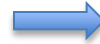
Results and discussion *Morphology evolution*



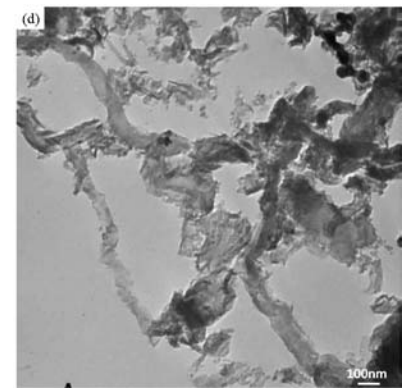
Pristine CNTs



Partially unzipped

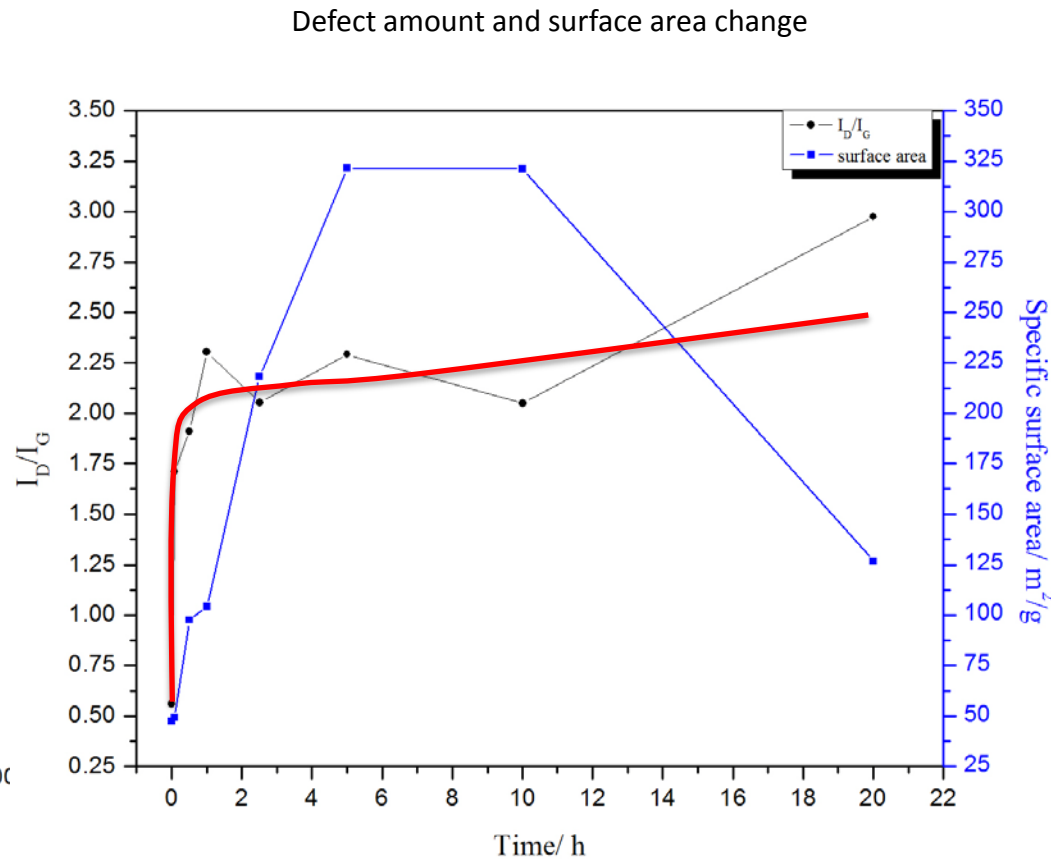
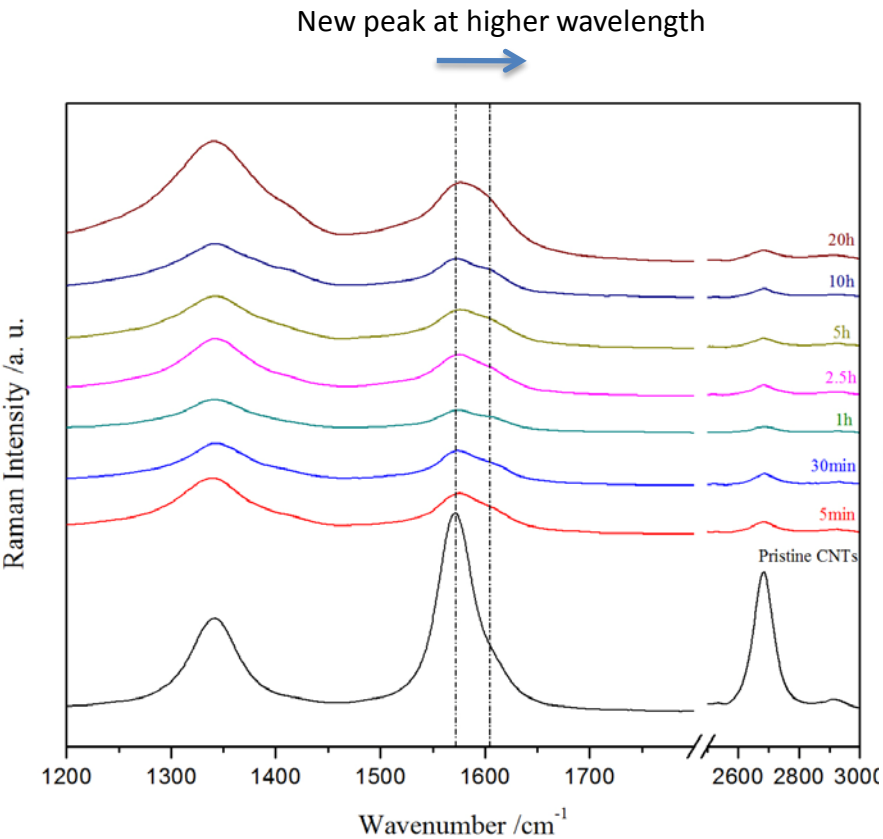


Fully unzipped



Fragmentation

Results and discussion *Raman spectra and BET surface area*



Effect of functional groups

After 5h acid treatment
With and without annealing

