

Gas-phase Synthesis of Metal Alloy and Carbon Nanotube Decorated Graphene Balls

Mohammad Moein Mohammadi, Santosh Srivatsa Gunturi, Shikuan Shao, Mohammad Malekzadeh, Mayuresh Keskar, Raymond D. Buchner, Mark T. Swihart

INTRODUCTION

■ Graphene is a single atomic layer of sp^2 hybridized carbon atoms with unique thermal, electronic and chemical properties.

■ High cost and low yield synthesis of graphene limit its commercial use.

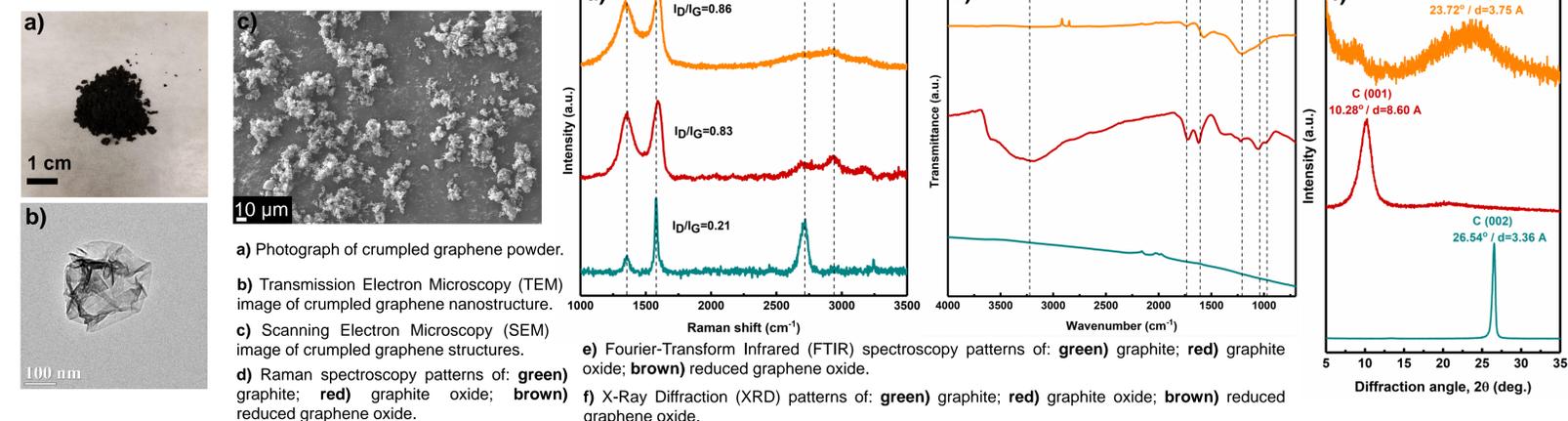


Our work:

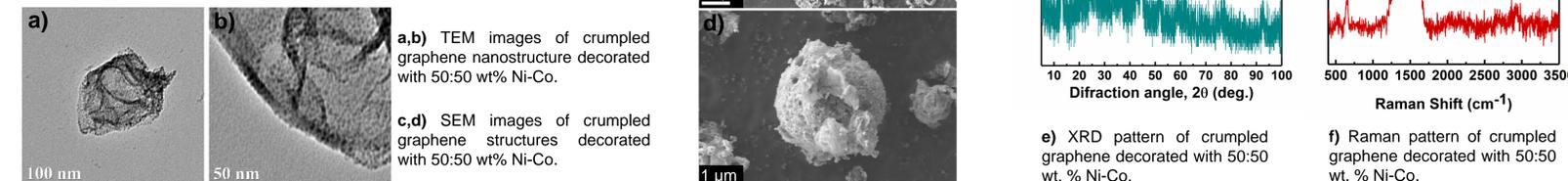
Rapid and economical reduction of graphene-based structures using a flame-based process; Capable of decorating graphene structures with transition metal nanoparticles in one step.

RESULTS

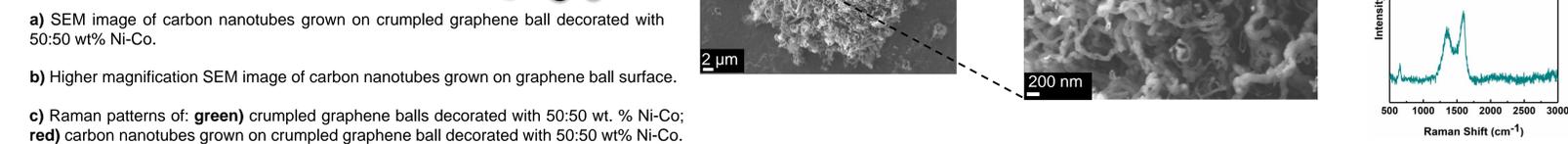
1 Crumpled Reduced Graphene Oxide Nanostructures



2 Ni-Co Decorated Crumpled Graphene Balls



3 Carbon Nanotube Decorated Crumpled Graphene Balls

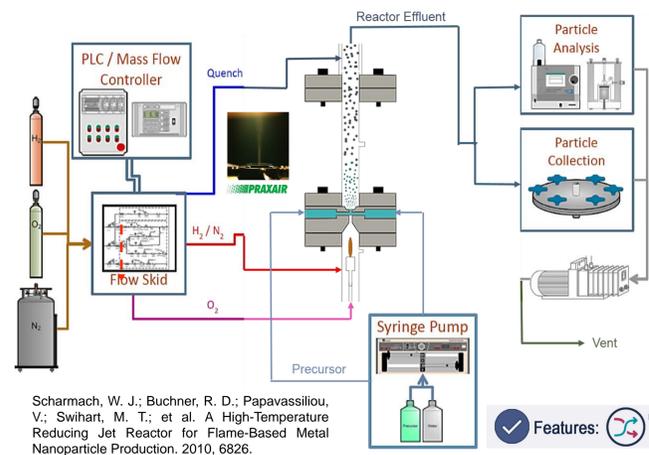


CONCLUSION & FUTURE WORK

- Synthesized crumpled reduced graphene oxide structures in a flame-driven high temperature reducing jet reactor.
- Decorated crumpled graphene balls with multicomponent metal nanoparticles (Ni-Co) during the graphene oxide reduction process inside the reactor.
- Grew carbon nanotubes on the graphene-Ni-Co balls using chemical vapor deposition.
- Structures will be optimized and used in energy related applications.

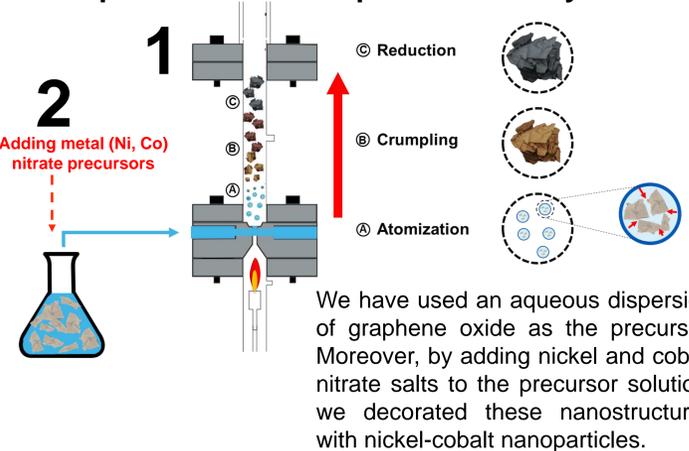
METHOD

High Temperature Reducing Jet (HTRJ) Process



A fuel-rich hydrogen flame passes through a converging-diverging nozzle. An aqueous metal precursor solution injected at the throat section of the nozzle is atomized by the high velocity gas stream. The resulting droplets evaporate and the precursor decomposes, initiating nucleation of particles in a reducing environment containing excess H_2 . After the reaction zone, particles are cooled immediately to prevent further particle growth and coalescence.

Crumpled Reduced Graphene Oxide Synthesis



Chemical Vapor Deposition

