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Uses for Graphene

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USES FOR GRAPHENE

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CHE 101-006

10/23/16

INTRO

- GRAPHENE IS A SINGLE LAYER OF PURE CARBON ATOMS
- HAS MUCH DIFFERENT CHEMICAL PROPERTIES THAN GRAPHITE, WHAT IT IS MADE FROM
- EXTREMELY HARD TO PRODUCE 100% PURE GRAPHENE
- ONLY RECENTLY HAS GRAPHENE BECOME KNOWN TO BE USEFUL
- (DE LA FUENTE, "GRAPHENE- WHAT IS IT?")

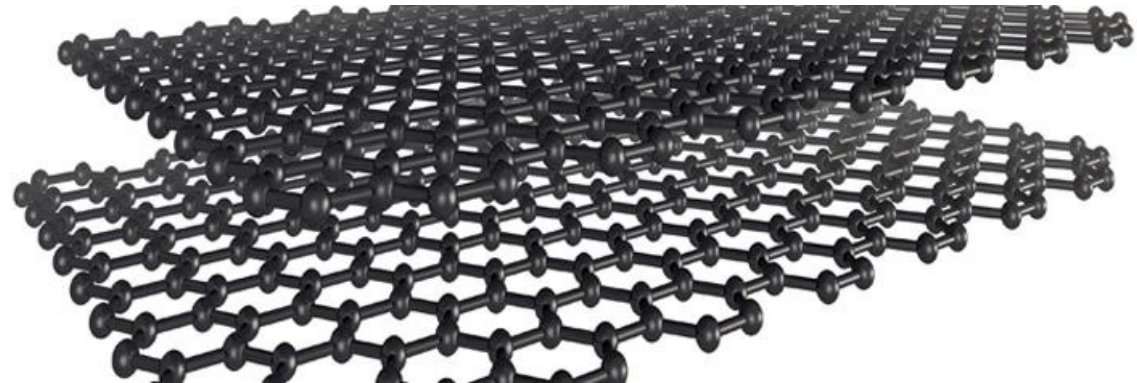
DESCRIPTION OF GRAPHENE

- PURE GRAPHENE IS MADE OF ONLY GRAPHITE ATOMS
- GRAPHENE IS MADE EITHER MECHANICALLY OR THROUGH CHEMICAL METHODS
- THINNEST AND LIGHTEST COMPOUND KNOWN BY MAN
- SECOND MOST ABUNDANT ELEMENT IN OUR BODIES
 - SAFE TO USE FOR HEALTH, VERY ECOLOGICALLY FRIENDLY

(DE LA FUENTE, "GRAPHENE-WHAT IS IT?")

GRAPHENE

- SHOWN IS TWO LAYERS OF GRAPHENE
- WHEN GRAPHENE IS LAYERED, IT BECOMES GRAPHITE, AND WHEN GRAPHITE IS SEPARATED INTO SINGLE LAYERS, IT BECOMES GRAPHENE
- GRAPHENE IS A TERM USED TO DESCRIBE A SINGLE LAYER OF GRAPHITE ATOMS
- (DE LA FUENTE, "GRAPHENE- WHAT IS IT?")



(De La Fuente, "Graphene-What is it?")

USES FOR GRAPHENE

- TECHNOLOGY INDUSTRY

- FASTER CHARGING, LONGER LIFE BATTERIES
- GRAPHENE SENSORS FOR 3D CAMERAS
- NIGHT VISION ON SELF-DRIVING CARS
- FLEXIBLE GRAPHENE WI-FI RECEPTORS
- GRAPHENE SENSORS FOR SMARTPHONES

(CARTER ET AL., "20 WAYS GRAPHENE IS ABOUT TO CHANGE YOUR LIFE")

- HEALTH INDUSTRY

- ROBOTIC GRAPHENE HANDS
- GRAPHENE CONTACTS TO CURE BLINDNESS
- GRAPHENE E-TATTOOS AND FITNESS TRACKERS
- GRAPHENE MOTORCYCLE HELMET

(CARTER ET AL., "20 WAYS GRAPHENE IS ABOUT TO CHANGE YOUR LIFE")

RESEARCH ARTICLE SUMMARY

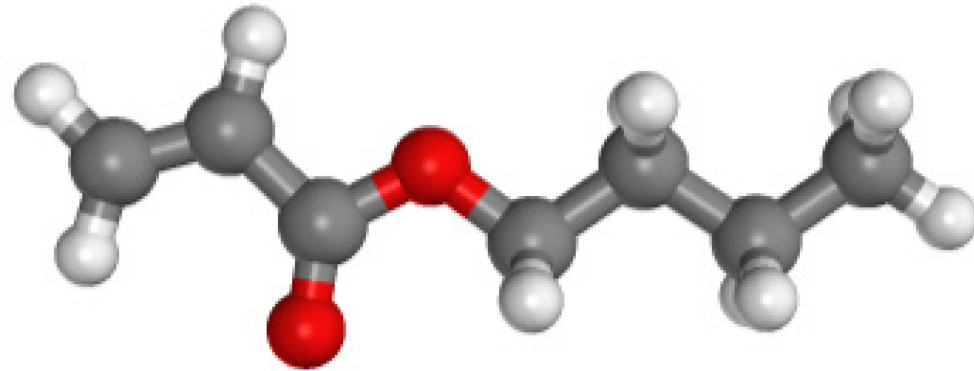
- GRAPHENE WAS USED AS A POLYMERIZATION BUTYL ACRYLATE
- GRAPHENE HAS A HIGH NUMBER OF FREE RADICALS, USEFUL TO BREAK BONDS WITHIN COMPOUNDS LIKE BUTYL ACRYLATE
- THE HIGH FREE RADICAL CONTENT IS ACTUALLY TOO HIGH, AND ENDS THE POLYMERIZATION TOO QUICKLY
- THROUGH REDUCTION, OR THE REMOVAL OF FREE RADICALS, THE EFFICIENCY OF GRAPHENE WHEN USED IN THE BUTYL ACRYLATE POLYMERIZATION PROCESS INCREASES
- GRAPHENE IS GIVEN THE NAME OF GRAPHITE OXIDE(GO) AND REDUCED GRAPHENE IS CALLED REDUCED GRAPHITE OXIDE(RGO)

(KOMEILY NIA ET AL. 1)

WHAT IS BUTYL ACRYLATE?

- BUTYL ACRYLATE
 - USED TO MAKE ACRYLIC POLYMERS AND POLYETHYLENE
 - COMPONENT IN CLEANING PRODUCTS, AQUEOUS RESIN, AND DISPERSIONS FOR TEXTILES AND PAPER
 - CLEAR, COLORLESS, FLAMMABLE LIQUID WITH SHARP ODOR

(ICIS CHEMICAL BUSINESS, "CHEMICAL PROFILE: BUTYL ACRYLATE")



(NIH 3D PRINT EXCHANGE)

HOW IT'S DONE

- GRAPHENE SHEETS ARE MADE FROM CHEMICAL EXFOLIATION OF GRAPHITE TO MAKE GRAPHENE OXIDE
- AFTER GRAPHENE SHEETS ARE MADE, THEY HAVE A HIGH FREE RADICAL CONTENT
- TO MAKE THE POLYMERIZATION PROCESS THE MOST EFFICIENT, THE NUMBER OF FREE RADICALS MUST BE REDUCED
- THIS IS DONE BY LIGHT IRRADIATION, THERMAL, AND CHEMICAL TREATMENTS FOLLOWED BY FURTHER OXIDATION BY ACIDS TO FIND EFFICIENCY OF EACH METHOD

(KOMEILY NIA ET AL. 703)

HOW IT'S DONE, CONT.

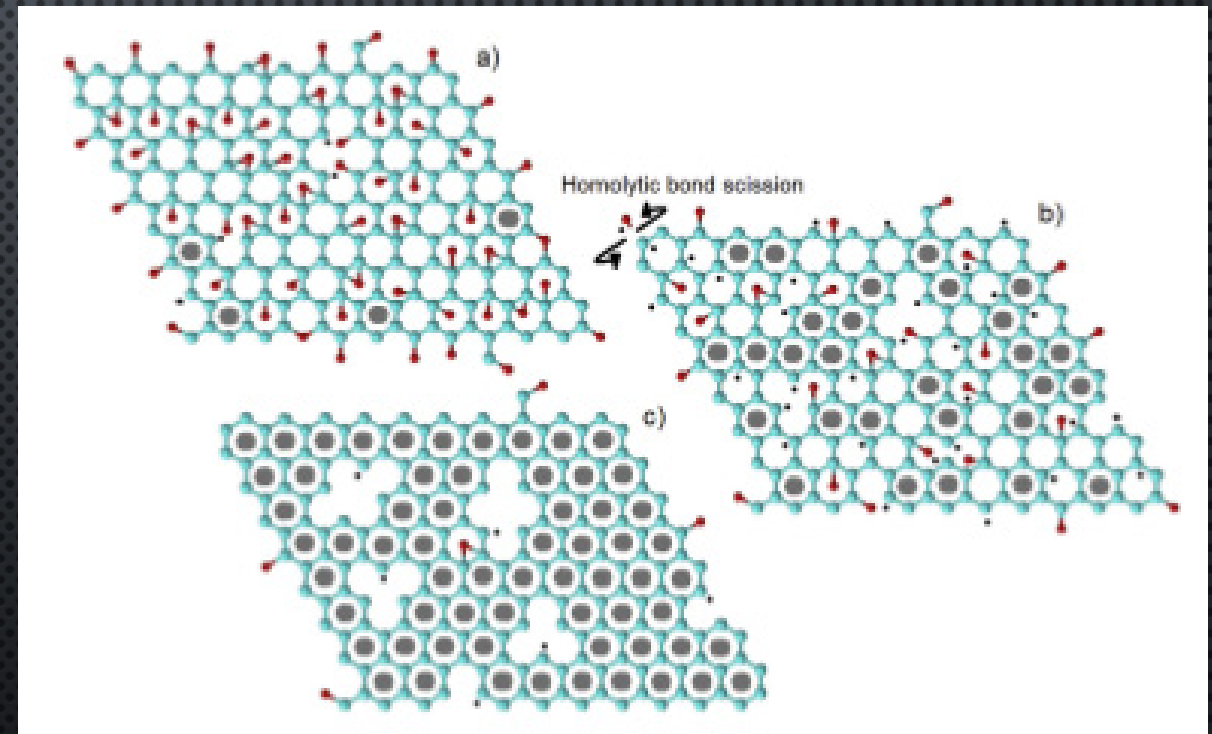
- REDUCTION REMOVES FUNCTIONAL GROUPS FROM NANOSHEET, REMOVING DANGLING BONDS AND/OR FREE RADICALS
- AFTER THE REDUCTION, GRAPHENE IS INTRODUCED TO A SAMPLE OF BUTYL ACRYLATE
- THIS BEGINS THE POLYMERIZATION PROCESS, WHICH HAS A DIFFERENT EFFICIENCY RATE FOR EACH WAY THE GRAPHENE WAS REDUCED

(KOMEILY NIA ET AL. 708-711)

REDUCING GRAPHENE RADICALS

- THIS PICTURE SHOWS THE PROCESS OF REDUCING A GRAPHENE SHEET
 - (A) SHOWS GRAPHITE OXIDE(GO)
 - (B) SHOWS PARTIALLY REDUCED GRAPHITE OXIDE
 - (C) SHOWS HIGHLY REDUCED GRAPHITE OXIDE(RGO)
- AS SHOWN, THE NUMBER OF FREE RADICALS DECREASE AS A SHEET OF GRAPHENE IS REDUCED UNTIL VERY FEW REMAIN

(KOMEILY NIA ET AL. 709)

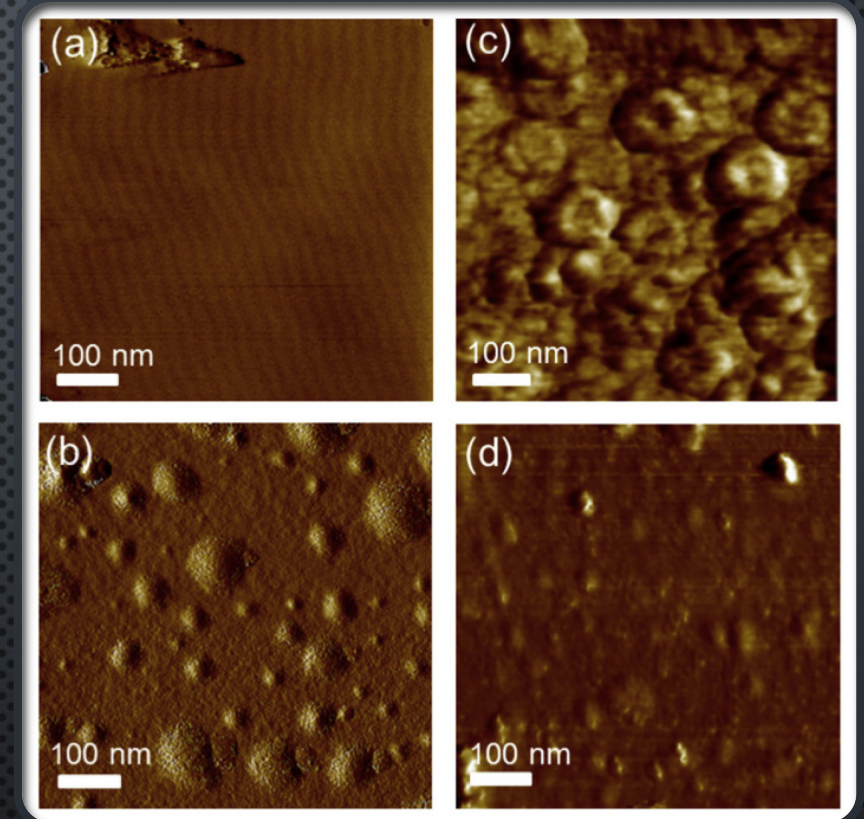


(Komeily Nia et al. 709)

USING GRAPHENE TO POLYMERIZE

- THESE PICTURES SHOW GRAPHENE RADICALS BEING USED TO INITIATE POLYMERIZATION
 - (A) SHOWS GO TO POLYMERIZE THE SURFACE OF A BARE SILICON WAFER
 - CONSIDERED THE CONTROL
 - (B) SILICON WAFER COATED WITH RGO MADE FROM 4 HOURS OF UV IRRADIATION
 - (C) SILICON WAFER COATED WITH RGO MADE FROM 24 HOURS OF UV IRRADIATION
 - (D) SILICON WAFER COATED WITH GO
- THIS GROUP OF PHOTOS SHOW THE INCREASE IN EFFICIENCY OF GRAPHENE AS IT IS REDUCED MORE

(KOMEILY NIA ET AL. 709)



(Komeily Nia et al. 709)

HOW OPTIMIZING FREE RADICALS IN GRAPHENE IS USEFUL

- USEFUL IN INDUSTRY TO MAKE BUTYL ACRYLATE POLYMERIZATION MORE EFFICIENT, SAVES MONEY AND TIME
- GRAPHENE OXIDE IS HARD TO CREATE AND KEEP AS SINGLE SHEETS OF CARBON
- FROM THIS, A PROMISING LOOK IS TO USE THIS NATURAL ATTRACTION TO POLYMERS THAT GRAFT ONTO OR ABSORB THE GRAPHENE SHEETS THAT COULD RESULT IN EXTREMELY STRONG COMPOSITE MATERIALS
- THIS EXPERIMENT SHOWED THAT THE REDUCTION OF GRAPHENE IS USEFUL WHEN CONTROLLED AND OPTIMIZED FOR USE IN POLYMERIZATION OF BUTYL ACRYLATE

(KOMEILY NIA ET AL. 710-711)

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