# BIO ADSORBENT DERIVED NANOMATERIALS AND ITS SURFACE MODIFICATION FOR HEAVY METAL ADSORPTION

by

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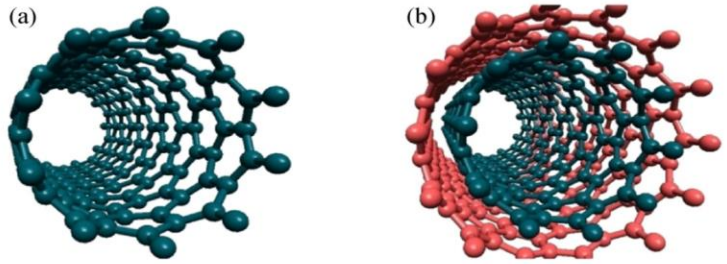
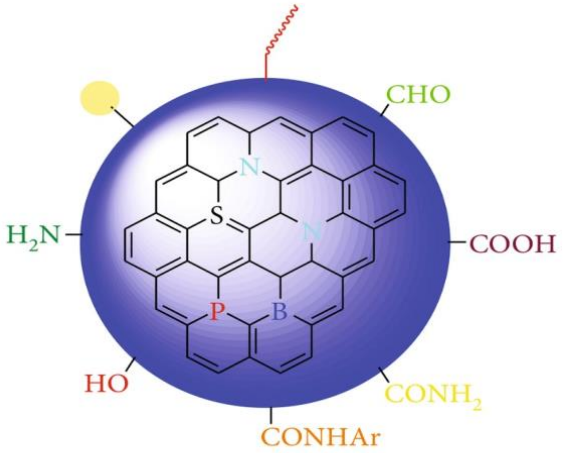
# CONTENT

- A brief introduction to the “bio adsorbent derived nano materials and its surface modification for heavy metals adsorption” that is going to be present.
- Synthetic procedure of Carbon Nano Tube and Carbon Nano Dot as a bio adsorbent derived nano materials for heavy metal adsorption.
- Surface modification of Carbon Nano Tube and Carbon Nano Dot for the adsorption of heavy metal ions.
- Conclusion/summary

# INTRODUCTION




(a) SWCNT & (b) MWCNT




*A* generalized structure of CND

**Carbon Nano Tube (CNT):-** It is an allotropes of $sp^2$ hybridized carbon with a cylindrical nano-structure including six membered carbon rings.

**Types of CNT:-**

a) Single-walled carbon nano tube (SWCNT)

b) Multi-walled carbon nano tube (MWCNT)

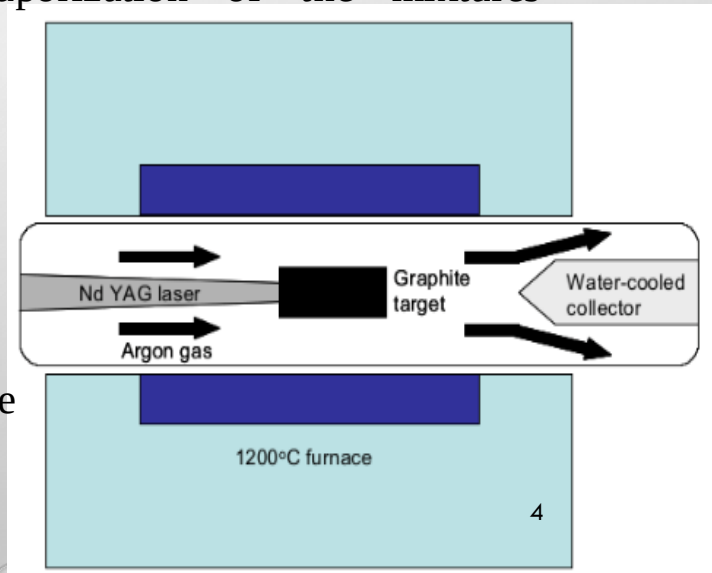
**Carbon Nano Dots (CND):-** It is a new type of carbon Nanomaterials which has sizes of below 10 nm with generally spherical shape. Carbon nano dots are composed of both $sp^2$ and $sp^3$ hybrid carbon networks.

# SYNTHESIS PROCEDURE OF CARBON NANO TUBES

**Carbon Nano Tube** can be synthesized by various methods such as Arc-discharge method, Laser-ablation technique. However, In general CNTs is made up of cylindrical sheets of graphite, rolled into tube. So it is essentially the allotropic forms of carbon.

The single-walled carbon nanotubes (SWCNT) can be synthesized by laser vaporization of the mixtures of carbon (graphite) and transition metal as a catalyst, located on the target.

- *Mechanism*: As the target is vaporized, a cloud of C, $C_2$, $C_3$, and catalyst vapour is being formed very quickly. When cloud cools, the carbon species with small molecular weight then combines to form large molecules. The vaporized catalyst condenses slowly and sticks fast to carbon cluster to prevent their closing into cage structures. The growth of this molecule continues to form SWCNT until either the catalyst clusters are too larger or until the condition have cooled.




*A schematic diagram of Laser-ablation apparatus*

# SYNTHESIS PROCEDURE OF CARBON NANO DOT (CND)

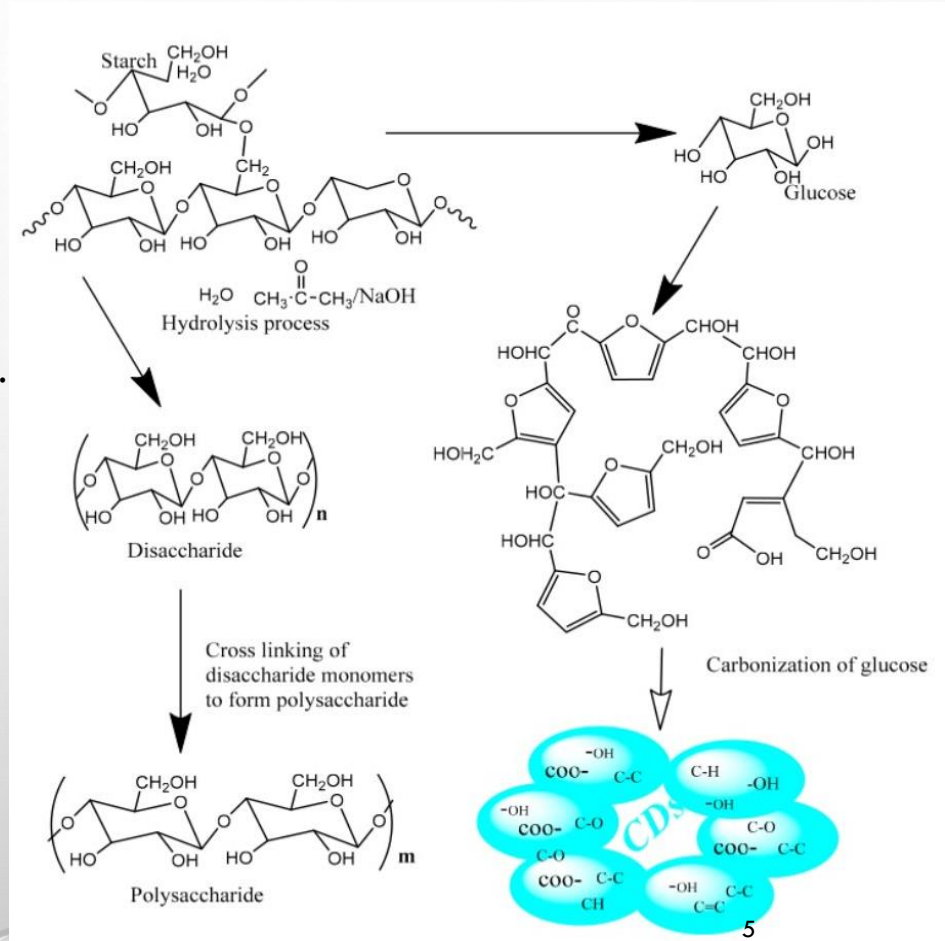
Carbon Nano Dot is synthesized from tapioca (extracted from storage root of cassava plants), i.e; a bio adsorbent derived nanomaterial for heavy metals Adsorption such as Lead, Pb(II) from aq. solution through Hydrothermal method.

- Tapioca flour is mixed with D.I $H_2O$/ $(CH_3)_2CO$/ NaOH as a solvent.

Further, the mixture is subjected to an oven for heating, which leads to the formation of glucose and disaccharide.

- The desired product "Carbon nanodots or CDs" is produced

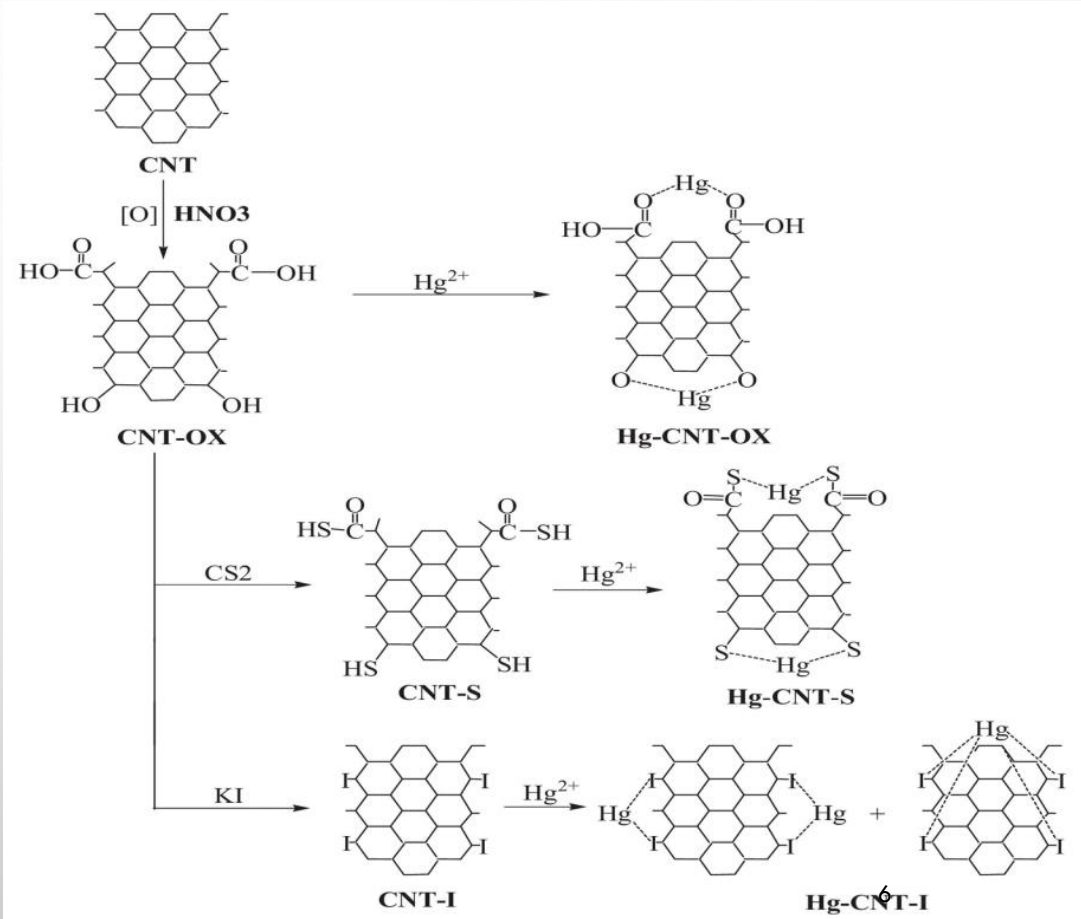
through the carbonization of Glucose. The synthesized CND has functional groups such as COO-, CH, C=O, C=C, -OH, C-O-C afloat on the surface.




*Mechanism for the synthesis of CND or CDs*

# SURFACE MODIFICATION OF CARBON NANO TUBES

- The surface modification of Carbon Nanotubes or CNT using acids as a reagents, and their mechanism for the adsorption metal ions on modified CNT's surface.
- In the Oxidized Carbon Nanotubes (CNT-OX), Iodide incorporated carbon nanotube (CNT-I), and sulfur incorporated carbon Nanotubes (CNT-S), adsorption of heavy metal ions occurs because of the bounding between the Mercury: Hg(II) metal ions and various functional group such as carboxyl (-COOH), hydroxyl (-OH), and sulfur ligands (-SH).

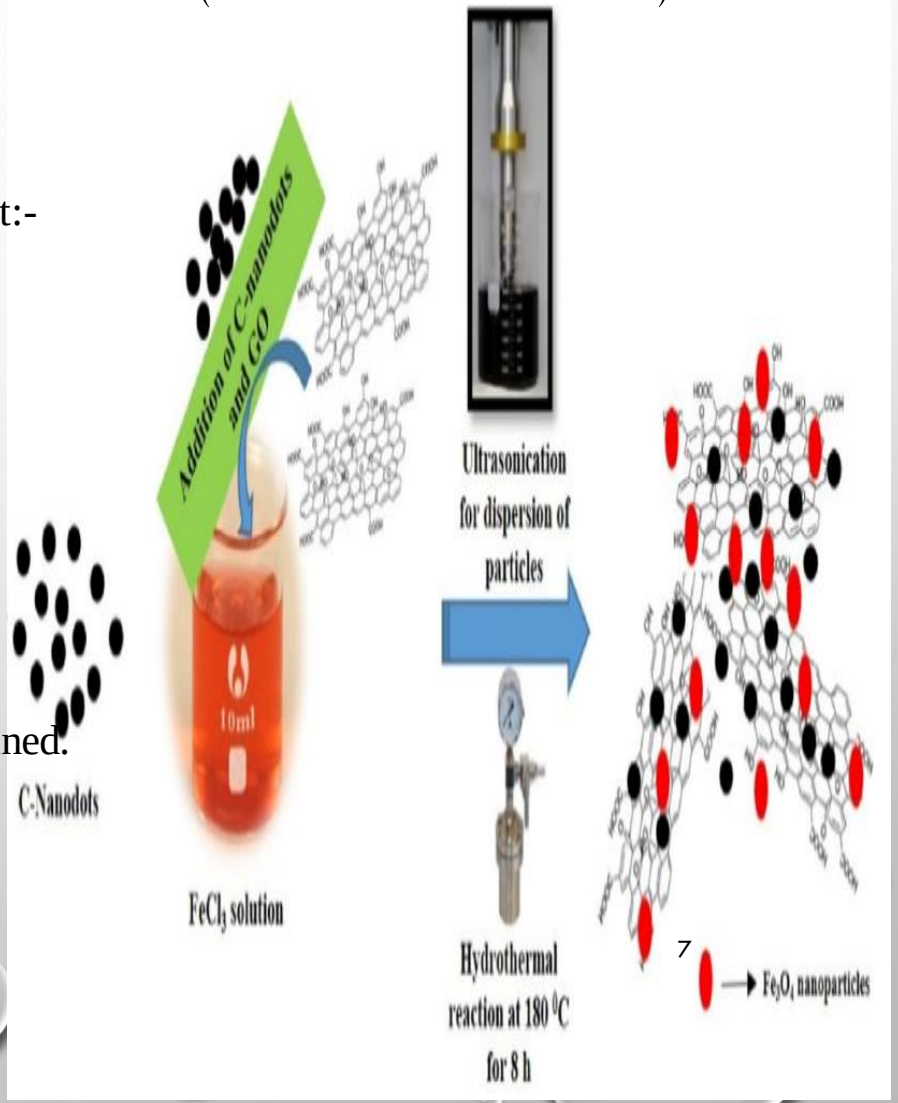



*Mechanism for surface modification and adsorption of heavy metal ions.*

# SURFACE MODIFICATION OF CARBON NANO DOT (C-NANODOTS)

The synthesis and surface modification of Magnetic carbon nano dot as bio adsorbent:-

- C-nanodots is synthesized by adding deionized pure water into the cow's milk and further subjected to hydrothermal synthesis unit.
- $FeCl_3$ ,sodium acetate , Graphene oxide and C-nanodot is mixed to form resulting solution followed by utlrasonic vibration Process. Further it is subjected to hydro-thermal synthesis reactor, and a magnet is used to separate the desired particle. Thus $Fe_3O_4$@Carbon-nanodots@Graphene-oxide hybrid materials as an adsorbent is obtained.
- Adsorption takes place due to the interaction between the metal ions and the functional groups such as hydroxyl (-OH), carboxyl (-COOH) present on surface of adsorbent.



# CONCLUSION/SUMMARY

- In this Project work, I have been studied, the Synthesis procedure of different biosorbent derived nanomaterials such as Carbon nanotube & Carbon nanodots and their surface modification for adsorption of heavy metal ions.
- The modified Carbon nanotubes such as CNT-S, CNT-OX, and CNT-I are used for adsorption of Mercury(II) metals.
- Although CNTs is of high costs, But it still may be favorable because of its high adsorption capacities, and this will reduce its high price. Cost can be reduced, because of its frequent accessibility and recyclization or regeneration.
- A modified Magnetic Carbon nanodots adsorbent is synthesized using green synthesis approach. And, The Carbon Nano Dot which is derived from tapioca plant is used for the adsorption of Lead(II) metal ions from aqueous solution. CND has advantages such as low toxicity, Inert chemicals, and simple functionalization.

# THANK YOU

CH499: PROJECT-II