Outreach Activity: School and public event

Preparation and testing of multifunctional nanocomposites for the purification of organic dye contaminated water

Venue: Young Scientist Centre, Darwin Building, UCLan, Preston, UK

UCLAN AND ROYAL INSTITUTION
YOUNG SCIENTIST CENTRE
YSC

Date: Open

Introduction: The lack of clean water has always been an issue of environmental concern all over the world. Today this environmental issue is primarily a concern in developing countries. The main sources of water pollution are (i) industrial (chemical, organic, thermal and nuclear wastes), (ii) municipal (largely sewage consisting of human wastes, other organic wastes, and detergents), and (iii) agricultural (animal wastes, pesticides, and fertilizers). A survey has been conducted by the World Health Organization (WHO) showed that 80% of total reported diseases are due to contaminated drinking water. A third of the world's population lives in water-stressed countries. By 2025, this is expected to rise to two-thirds when the problem of water stress is conflated by poor infrastructure and dense populations, the consequences could be devastating.

UCLan is leading this multinational project on nano-water technology (www.nano-water.org) where **Dr Tapas Sen**, project lead will introduce the concept of nanoscience and their application in our daily lives (see Figure 1) and will assist you in today's laboratory session with the help of **Dr Liz Granger** in the Young Scientist Centre at UCLan.

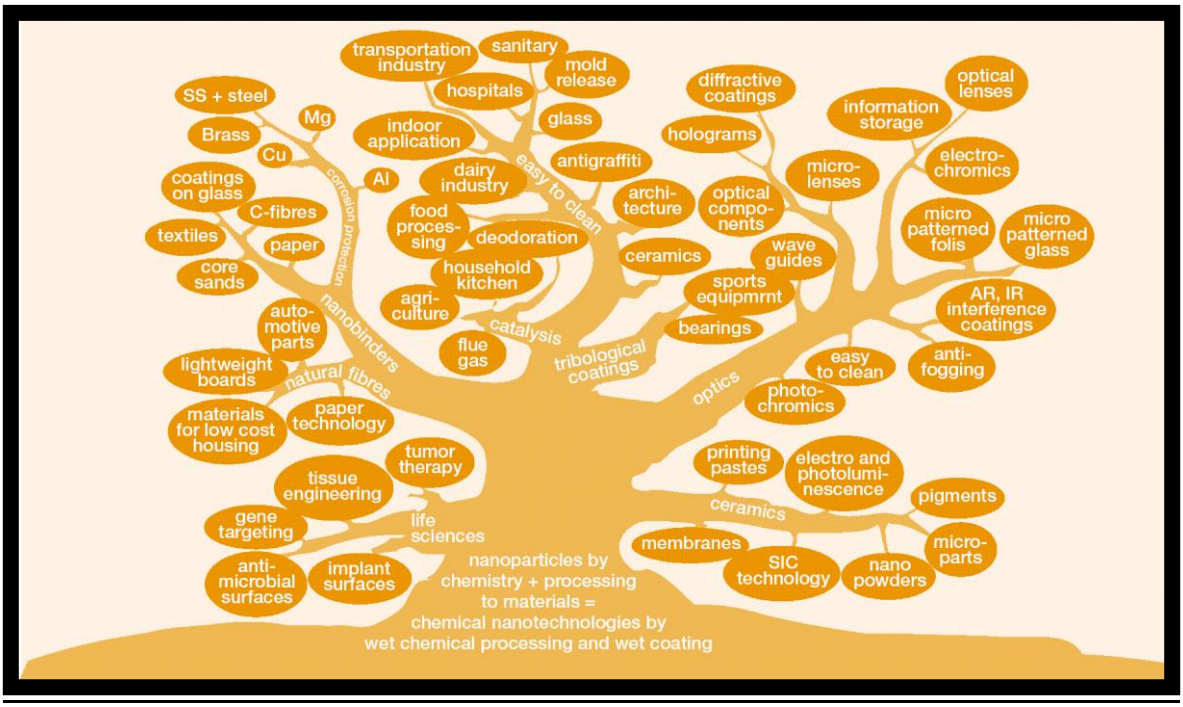

Figure 1: Applications of nanomaterials in our daily lives

COSHH ASSESSMENT: Please read the safety information carefully before beginning the practical

HEALTH & SAFETY

Substances (used or produced as by-products or wastes)	**Quantity**	**Hazard Class**	**WEL**	**Exposure Route(s)**	**Frequency and Duration of Exposure**	**Known Health Effects:**
Ferric Chloride	1mL	Harmful irritant	NA	Ingestion, Dermal	Maximum period of 1 Hour	May cause skin and eye Irritation
Ferrous Chloride	2mL	Harmful Irritant	N/A	Ingestion, Dermal	Maximum period of 1 Hour	May cause skin and eye Irritation
Activated Charcoal	0.2g	Irritant	N/A	Inhalation, Ingestion	Maximum period of 1 Hour	May cause eye Irritation May irritate sinuses/tract if inhaled
Methylene Blue	1mL	Harmful Irritant	NA	Ingestion and inhalation	Maximum period of 1 Hour	May cause skin and eye Irritation May irritate sinuses/tract if inhaled
Ammonium hydroxide 1 Molar	50mL	Poison	PEL 50 ppm STEL 35p pm	Skin / ingestion	Maximum period of 1 Hour	Causes irritation to respiratory tract. Can cause burns

APPARATUS FOR PREPARATION AND TESTING OF MULTIFUNCTIONAL NANOCOMPOSITES

Conical flask (100mL)
Burette
Pasture pipette
Magnetic stand
Microtubes

SUPPLIED SOLUTION

1. Ferrous chloride (1M) in deionised water
2. Ferric Chloride (1M) in deionised water
3. Ammonium hydroxide (1M) in deionised water
4. Organic dye (Methylene blue) contaminated water to be cleaned
5. Deionised water

SUPPLIED SOLID

Black magic nanopowder

EXPERIMENTAL

Task 1: Preparation of magnetic nanoparticles embedded with black magic nanopowder

Step-1
Add 1mL of supplied solution 1 into 2mL of supplied solution 2 in a 100mL conical flask.

Step-2
Fill 50mL of solution 3 in a burette. Add solution 3 drop wise from the burette into the mixture from step-1 over a period of approximately 10 minutes at room temperature whilst mechanically stirring the conical flask using your hand. Stir the resultant mixture for a further 5 minutes. Note down the colour change of the whole mixture during the addition of solution 3.

Step-3
Take approximately 1ml of the reaction mixture from step-2 using a pasture pipette to a 1.5 mL microtube and place them in the supplied magnetic stand. Observe their magnetic response. Remove the supernatant using a Pasteur pipette. Add supplied black magic powder in your washed black nanoparticles and add 1ml deionised water. Stir the reaction mixture for a minute and place the tube in the magnetic stand. Wait until the solid separate from the clear supernatant. Remove the supernatant by using the Pasteur pipette.

Task 2: Preparation of magnetic nanoparticles embedded with magic nanopowder

Add 1mL dye contaminated water (supplied solution 4) into the washed materials from task 1 (Step-3) and stir for a minute. Place the mixture once again in the magnetic stand and note down the colour of the supernatant. Take the supernatant out and check the colour. It should be clean water.
Re-use the materials for decontamination of water: Add 1mL dye contaminated water (supplied solution 4) into the washed materials from task 1 (Step-3) and stir for a minute. Place the mixture once again in the magnetic stand and note down the colour of the supernatant.

Chemical Reaction involved for the synthesis of superparamagnetic iron oxide nanoparticles (SPIONs) in task-1

$$2FeCl_3 + FeCl_2 + 8NH_4OH \longrightarrow \underset{\text{SPIONs}}{Fe_3O_4} + 8\,NH_4Cl + 2O_2$$

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More information about the project: https://nanowateratuclan.wordpress.com/

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