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

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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.

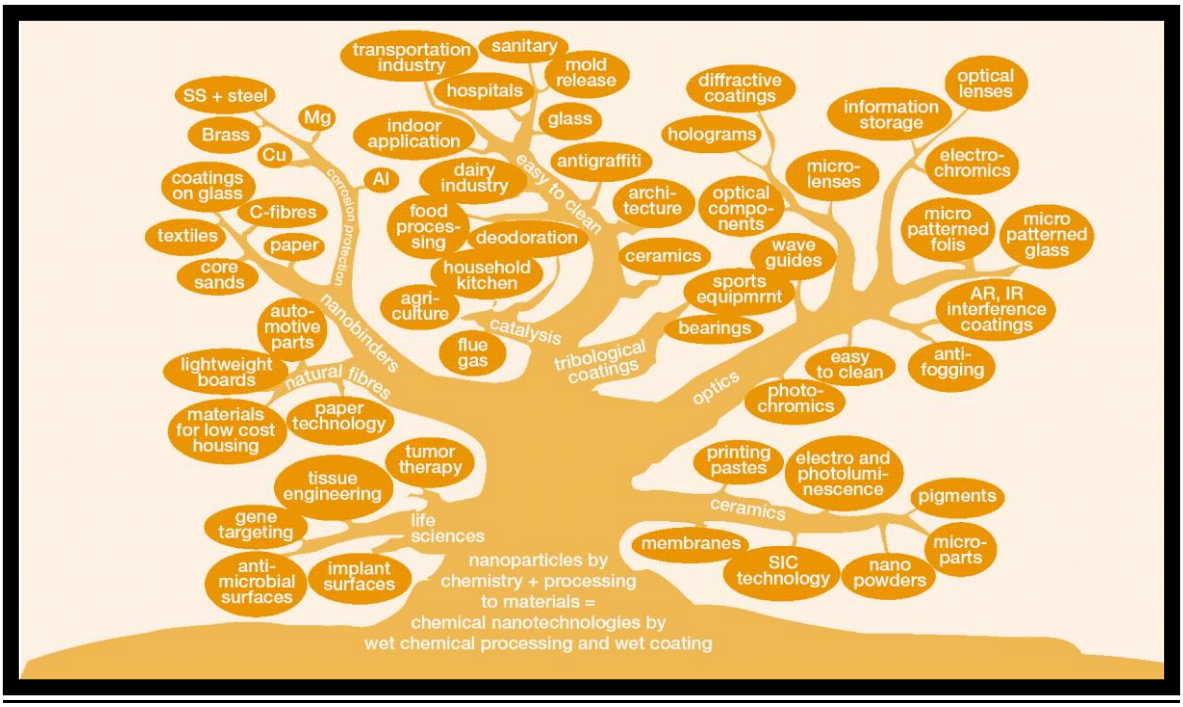

Figure 1: Applications of nanomaterials in our daily lives

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:**
Aqueous solution of Ferric Chloride	2mL	Harmful irritant	NA	Ingestion, Dermal	Maximum period of 1 Hour	May cause skin and eye Irritation
Aqueous solution of Ferrous Chloride	1mL	Harmful Irritant	N/A	Ingestion, Dermal	Maximum period of 1 Hour	May cause skin and eye Irritation
Black nanopowder	1 g	Irritant	N/A	Inhalation, Ingestion	Maximum period of 1 Hour	May cause eye Irritation May irritate sinuses/tract if inhaled
Methylene Blue contaminated water	1mL	Harmfull rritant	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	20mL	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

Falcon tubes (50 mL)
Pasture pipette
Magnetic stand
Eppendorf microtubes

SUPPLIED SOLUTION

1. 1 mL Ferrous chloride (1M) in deionised water in a small Eppendorf tube
2. 2 mL Ferric Chloride (1M) in deionised water in two small Eppendorf tubes
3. Ammonium hydroxide (1M) in deionised water
4. 2 times 1 mL organic dye (Methylene blue) contaminated water to be cleaned
5. Deionised water

SUPPLIED SOLID

1g black nanopowder in a small Eppendorf tube

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 50 mL Falcon tube. Stir for 1 mins by hand. Note down the colour of the solution.

Step 2
Add 1 g solid black nanopowder to step 1 solution and stir for 1 min by mechanical shaking using your hand. Check the magnetic response of the black nanopowder using a magnetic stand

Step 3
Add 20mL of solution 3 in the mixture in step 2. Stir the resultant mixture for 5 minutes. Transfer 1 mL of the suspension mixture in a small Eppendord tube. Place the Eppendorf tube in a magnetic stand. Check the magnetic response of the solid nanopowder. Note down the colour of the clear supernatant after the magnetic separation. Remove the supernatant using Pasture pipette. The magnetic black solid is now ready for use for water purification.

Step-4

Transfer supplied dye (methylene blue) contaminated water into the black solid magnetic nanopowder and stir for 30 seconds. Place the Eppendorf tube onto the magnetic stand. Note down the colour of the water. It should be colourless as the water is now pure without dye molecules. Take the clear water using a Pasture pipette.

Step 5: Transfer future 1 mL of supplied dye (methylene blue) contaminated water into the already used black solid magnetic nanopowder and stir for 30 seconds. Place the Eppendorf tube onto the magnetic stand. Note down the colour of the water. It should be colourless as the water is now pure without dye molecules. Take the clear water using a Pasture pipette.

One can continue the steps 4 and 5 repeatedly until the materials performance is degraded hence needing re-charging for further use.

Chemical Reaction involved for the synthesis of superparamagnetic iron oxide nanoparticles (SPIONs) embedded in black nanopowder during task 3.

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

Contact details of the project Lead at UCLan

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More information about the project: www.nanowateratuclan.org

More information about the programme: http://www.ukieri.org/