PROJECT SYNOPSIS FOR
46th SERIES OF STUDENT PROJECT PROGRAMME

Title of the Project	Investigation of Thermophysical Properties of Nanofluids for Heat Transfer Application
Project Reference No.	46S_BE_4812
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Introduction:

In recent years, the field of nanotechnology has gained significant attention in the realm of engineering and materials science. One promising area within this domain is the development and application of nanofluids, which are colloidal suspensions of nanoparticles in base fluids. Nanofluids possess exceptional thermal properties that can potentially revolutionize heat transfer processes in various industries.

This project focuses on the investigation of thermophysical properties of nanofluids for heat transfer applications, with a specific emphasis on carbon dots as the nanoparticle of interest. Carbon dots, also known as carbon quantum dots, are nanoscale carbon-based particles with unique properties, including high thermal conductivity, and excellent stability. These characteristics make carbon dots an intriguing candidate for enhancing heat transfer performance in various applications.

The primary objective of this study is to systematically analyze the thermophysical properties of nanofluids containing carbon dots. By preparing C-dot nanofluids with an economical one-step synthesis method, we aim to evaluate and understand their impact on critical thermophysical properties such as thermal conductivity, viscosity, specific heat capacity, and density. These properties play a pivotal role in determining the overall heat transfer performance of the nanofluid.

Moreover, this study can provide valuable insights into the fundamental mechanisms governing the heat transfer behaviour of nanofluids. The knowledge gained through this research can aid in the development of advanced heat transfer models and facilitate the design of more efficient thermal management systems.

Objectives:

The primary objectives of this project are to synthesize nanofluids containing carbon dots, evaluate their thermophysical properties, and analyze their potential for use in heat transfer applications. To achieve these objectives, we will perform a series of experiments to measure the thermal conductivity, viscosity, specific heat capacity, and density of the nanofluids.

The main objectives of our project are:

1. literature review on C-dot nanofluids for the heat transfer fluids applications.
2. Synthesis of C-dot nanofluids with an economical one-step synthesis method.
3. SEM or TEM Analysis of C-dot nanofluids.
4. Measure of thermophysical properties like thermal conductivity, viscosity, specific heat capacity, and density.
5. Evaluate the stability of the prepared C-dot nanofluids over time.

Methodology:

1. Materials:

The Deionized (DI) water (H_2O) is used as the base fluid, Ascorbic acid ($C_6H_8O_6$), which is an eco-friendly and low-cost material, is the carbon source. Sodium hydroxide (NaOH) was employed to control the pH and copper acetate ($(CH_3COO)_2\,Cu.H_2O$) was used as the catalyst. All the chemicals were procured from NICE Chemicals and used without any

further purification. The other consumables and safety gears has been procured from local chemist. The below figure depicts all the chemicals utilized for the synthesis of C-dot nanofluid

Fig. 1: Chemical used for synthesis of C-dot nanofluids

2. Preparation of Nanofluid:

- The Carbon Dots nanofluid can be prepared by a simple one-step method by dissolving Ascorbic acid in DI water. The pH of DI water can be varied using NaOH. The nanoparticles and Carbon Dots should be dispersed uniformly in the solvent, and the concentration of each component should be optimized to achieve the desired thermophysical properties.
- The procedure for preparing a small sample of C-dot nanofluid is listed as follows:

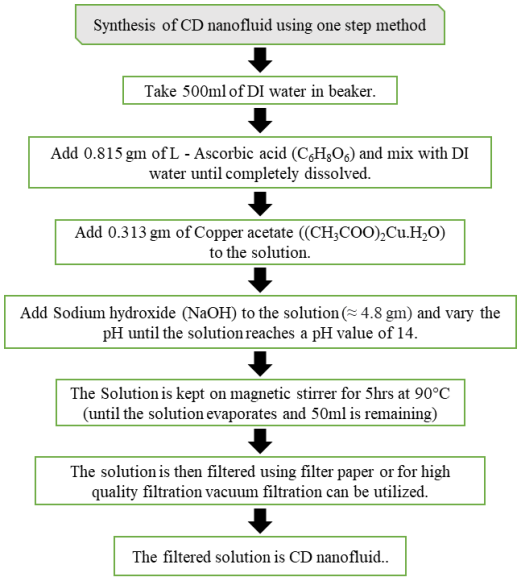

Fig. 2: One-step synthesis method for C-dot nanofluids

- The following pictures depicts the steps adopted to prepare a sample (DI 500ml) of nanofluid.

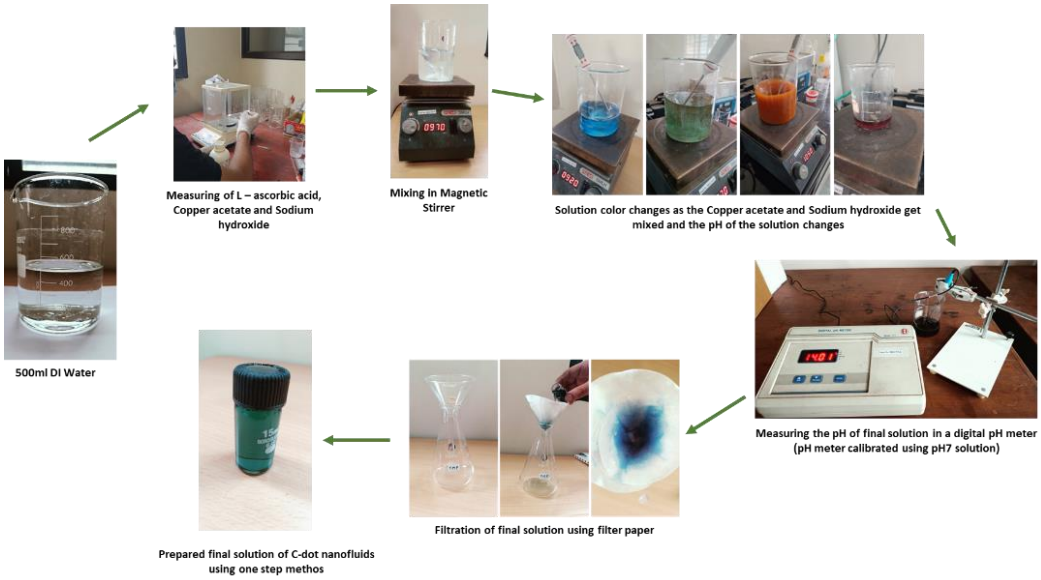

Fig. 3: One-step synthesis process adopted for C-dot nanofluids preparation

Results:

1. Scanning Electron Microscopy (SEM):

It is a powerful technique used to obtain high-resolution images and detailed information about the surface morphology and composition of solid samples. In the case of your carbon dot nanofluid, SEM analysis will allow us to determine the size and shape of the suspended nanoparticles after the liquid sample has been dehydrated. Dehydrating the liquid sample is a crucial step before performing SEM analysis. The procedure involves removing the liquid component from the sample, leaving behind the solid nanoparticles for examination. To dehydrate the liquid sample, we need to remove the solvent or liquid component while preserving the nanoparticles. The services for SEM analysis were obtained from Dextrose Technologies Pvt. Ltd.

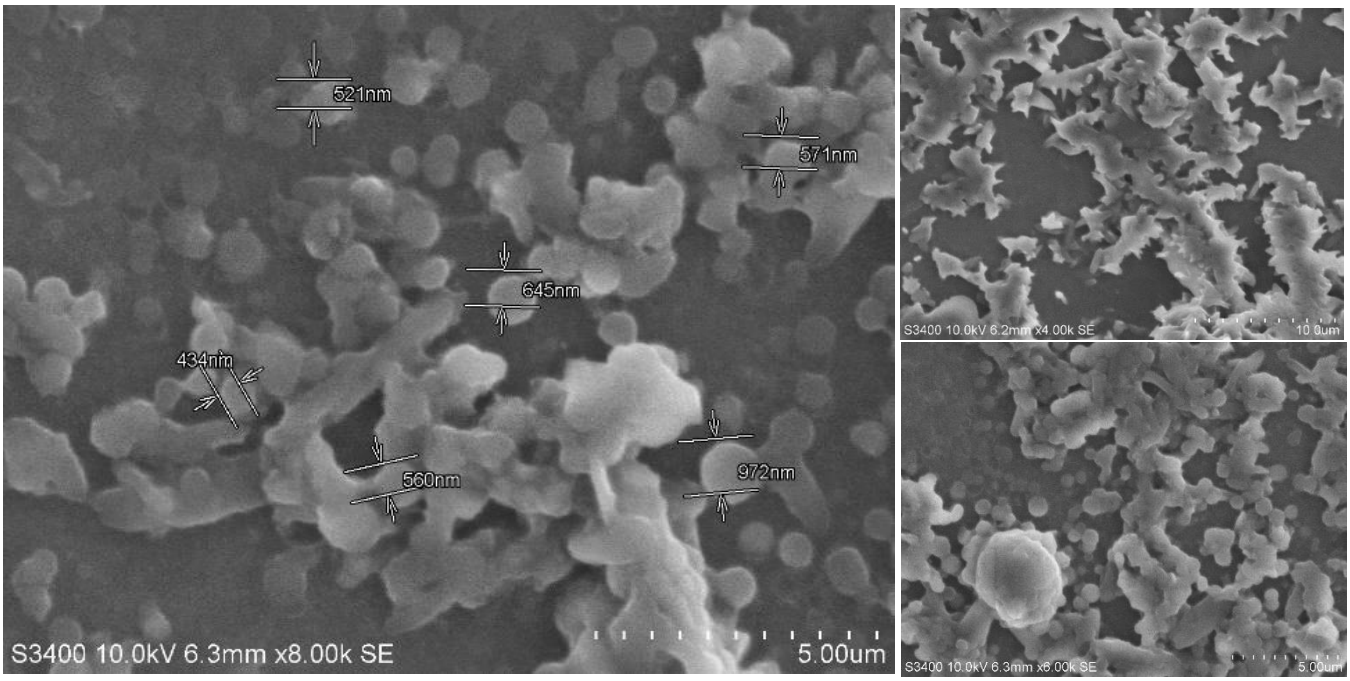

Fig. 4: SEM Images of Carbon Dots

The SEM analysis results as in Fig. 4 depicts that the average size of C-dot nanoparticles suspended in the fluid is approximately around 618nm due to which the current sample cannot be regarded as a nanofluid. The fluid in which the size of nano particles dispersed <100nm can only be regarded as nanofluid.

Conclusion:

Till the present stage of project, the results obtained for the prepared sample of C-dot nanofluid doesn't qualify the fluid sample to be called as nanofluid. The possible reason for these unsatisfactory results could be drawn from the improper procedure adopted for dehydrating the liquid sample. Hence the team has come to a conclusion to prepare a new sample of C-dot nanofluid and the size, distribution and morphological charecteristics will be determined by employing Transmission Electron Microscopy (TEM) analysis which can handle liquid sample. By this TEM analysis we can creep out the errors occurred due to dehydration of liquid sample and hence proper an accurate result can be obtained.

Scope for future work:

In the further stage of this project, the following things will be carried out.

1. New sample preparation of C-Dot nanofluid.
2. TEM analysis of C-Dot nanofluid.
3. Analysing the thermophysical properties like thermal conductivity, viscosity, specific heat capacity, and density of nanofluid.
4. Analysing the stability of C-dot nanofluid by observing the sedimentation over time.