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Production and Analysis of Copper Oxide from Nanotechnology for Thermal Applications

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Abstract

In this paper production and analysis of the copper oxide nanofluid from nanotechnology is discussed. Nowadays it becomes very difficult to increase the thermal conductivity rate, in order to overcome this problem nanofluids are produced. Copper nanofluid can be obtained by two methods namely 1. Double precipitation method 2. Two step method. The base material for this nanofluid is paraffin. Paraffin is used because the nanoparticles can be easily dispersed in it. The laser flash analysis (LFA) was used to measure the increase in thermal conductivity rate. With the help of solidification and melting curve analysis we can see a dramatic increase in thermal conductivity by dispersing all the nanoparticles in the sample than other base materials. In order to measure the thermal conductivity Differential Scanning Calorimetry (DSC) was used.. From this we can come to a conclusion that the usage of Copper nanofluids is one of the best way to increase the thermal conductivity for thermal applications.

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I. INTRODUCTION

When there occurs a slight change in temperature some matertials changes its state such materials are known as Phase Change Materials (PCM). PCMs are used in many different commercial applications where energy storage and stable temperatures are required, including, among others, heating pads, cooling for telephone switching boxes, and clothing. They are usually classified into two types, they are 1. Natural PCM's (Eg: paraffin, unsaturated fats) 2. Inorganic PCM's (Eg: metals, salt hydrates). PCM's has many properties they are low warm conductivity, warmth moves rate (HTR) and high thermal conductivity, high specific heat. In this warm conductivity and HTR of PCM's can be improved by various methods like 1. Earthenware particles, 2. Metallic particles, 3. Carbon particles. But nowadays due to advancement in nanotechnology many other methods were found to upgrade warm conductivity and HTR. The liquid is dispersed in the base liquid by scattering the nanopraticals. The particals that has round and barrel shape has an increased surface zone which helps in increasing the HTP. The thermal conductivity of the particals at the bottom is controlled by some factors. Some factors should be get away from the remains like surfactant and ultrasonifications. The nanoparticals has many applications in fields like mechanicals, electrical, thermal and other fields. There exist various methods to mix nanoparticals but we have selected ecofriendly methods. We have selected paraffin among other materials because it has may heating applications. But it may has low warm conductivity (0.22 W/mK). Paraffin has many properties namely atomic weight=353.77 g/mol density= 0.9 Kg/cm3 52-54°C n=1.42 Cp=2.13K J/KgK. In this paper the copper oxides is used a base fluid along with paraffin which has many heating applications. Here we use twofold precipitation technique. The CuO nanoparticles is then checked by using transmission electron magnifying instrument TEM and molecule size analyser (PSA) . The heating qualities of the copper oxide is checked by differential checking calorimetry and LFA. From the above testing we can come to a conclusion that paraffin is the best source for heating application.

II. MATERIALS USED:

Glacial acetic acid (CH_3COO) and Copper acetate ($Cu(CH_3COO)_2 H_2O$) were purchased from India. Sodium hydroxide (NaOH) pellets were purchased from Lobha Chemie. 2D water was used throughout the experiment. Paraffin is used as base fluid.

III. METHODS USED FOR ANALYSIS:

A. X-ray diffraction analyser (XRD):

A small amount of the sample is placed in plate called specimen plate and placed in X-ray chamber. . High intensity X-rays are made to pass through the sample and scattered. X-ray diffraction is used to find the crystal structure and chemical compositions.The scattering intensity and scattering angle are measured so that the crystal structure and chemical composition were calculated.

B. Particle size analyser:

Particle size analyser is an analyser used to calculate the average size of the particle at nano level. A few amount of CuO nanoparticle is mixed in DI water and kept in ultrasonification for 15mins. A homogeneous mixture is obtained. In polystyrene cuvettes container the solution and placed in the chamber. Laser beams of high intensity are made to passthrough the solution and average size of the particle was calculated.

C. Transmission electron microscope (TEM):

Transmission electron microscope (TEM) is a device in which a beam of electron is passed through the ultra thin specimen and image of the sample is obtained in the fluorescent screen. This technique is used in nanotechnology to measure the size of the particle and to get bright magnified image of the nanoparticles. A small amount of the sample is mixed in water and dried for few minutes. It is then placed in the sample chamber, and electron beam is passed through the specimen. Highly magnified image of each particle is reflected in the fluorescent screen. The particle image and size is obtained by increasing the magnification.

D. Thermal characteristics analysis studies differential scanning calorimetry (DSC):

DSC is used to measure solidification point temperature, latent heat storage of the PCM mixture and melting point temperaturefor different amount heat applied. A tiny amount of mixture is placed in aluminium pan and placed in chamber. Nitrogen acts as a cooling medium. Heat is applied and peak is obtained corresponding to melting point temperature of the mixture. Then , heating setup is replaced to cooling setup and peak is obtained corresponding to solidification point temperature.

IV. RESULTS AND DISCUSSIONS

Characteristics Analysis of Nanoparticle

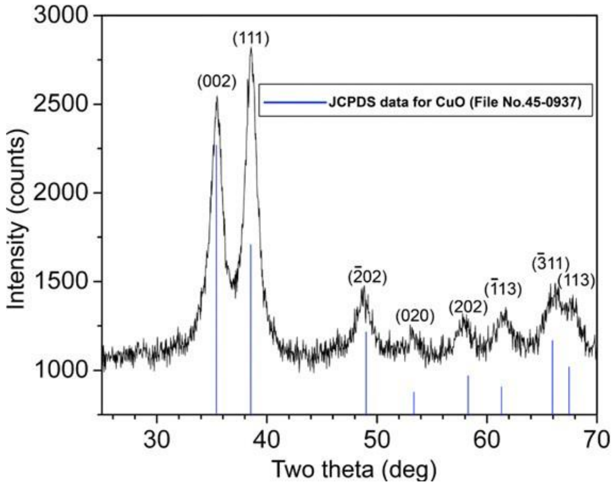

Figure 1: XRD pattern of CuO nanoparticles

X-Ray diffraction results infer that samples are CuO crystals. It does not contain any form of impurities. The broadening of the peak indicates that the particles are in nano level. The XRD graph in shown in Fig 1.

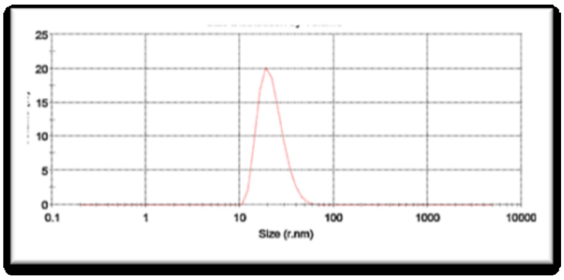

Figure 2: Particle size distributions

Particle size analyser (PSA) refers that particles dispersed in DI water was in the size range of 1 to 100nm. It also indicates there is no sedimentation of particles at the bottom. The single peak in the graph shows that all the particles dispersed was nano sized and dispersion was homogeneous without any agglomeration. It is represented in graph Fig:2

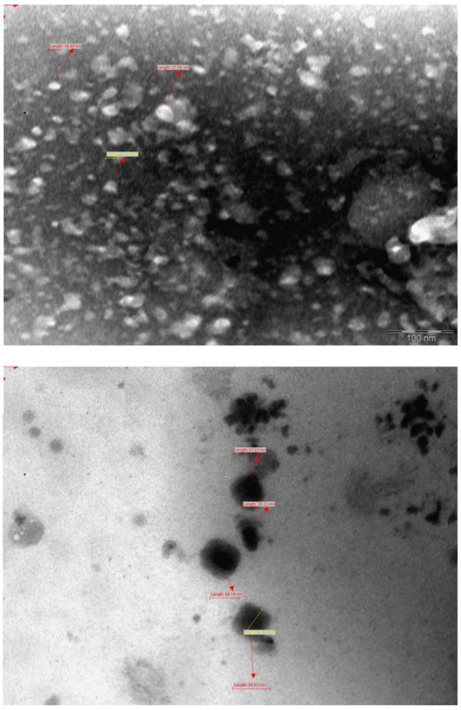

Figure 3: TEM images of CuO nanoparticlese

Transmission electron microscope (TEM) analysis indicates that there is no cluster formation of particles. All the particles were individual and size ranges from 1 to 80nm. TEM results also indicate that all particles are in spherical shape. The bright TEM image is represented in Fig: 3

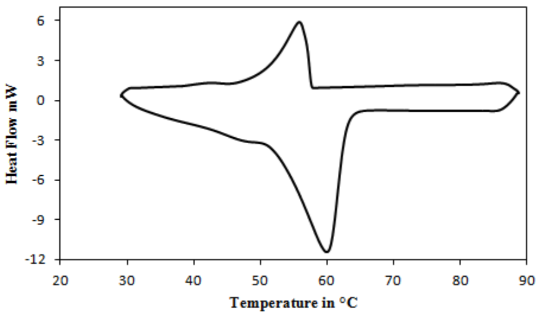

Figure 4: DSC measurements of CuO–paraffin nanofluids

Results obtained from DSC indicate that melting of the PCM starts from 48.4°C and ends at 62.8°C. Between the above-mentioned temperature the phase change of paraffin from solid to liquid occurs. The latent heat stored during heating process is 99.4KJ/Kg. solidification of the PCM composite starts from 57.68°C and ends at 46.1°C. The latent heat stored during cooling process is 104 KJ/Kg. The left small peaks between 46.6°C and 48.9°C. The complete result is available in graph form in Fig:4

LFA 447 nanoflash analyser results are represented in Fig:5. This result indicates that thermal conductivity increases with increase in concentration of nanoparticles. For 50% (0.5gms) concentration the thermal conductivity was enhanced by 75.2%. Thermal conductivity of pure paraffin is 0.235 W/mK. After dispersion of nanoparticles in PCM, it has improved to 0.412 W/mK.

V. APPLICATION

The CuO nanofluid is mainly used in heating application. In heating application, renewable source of energy can be used to get effective and efficient heating and also it doesn't create any hazard to the environment when compared to non- renewable resources. In solar based heating application Cuo can be used effectively which can increase the efficiency of the system and stores more energy than normal, which will be very useful in future.

VI. CONCLUSION

The examination of CuO-paraffin nanofluid as phase change material (pcm) for heating application was successfully carried out. The particle size analyser observes that cuo nanoparticles is mixed with paraffin so that a homogeneous mixture is obtained which in turn increases the thermal conductivity and HTR. The bond between paraffin and CuO is clearly steady. The warm dependability test states that the scattering of CuO nanoparticles in paraffin is a good strategy to enhance the thermal conductivity of nanofluid which will increase the thermal conductivity,thus making it a better phase change material (pcm).

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