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Nanoparticles dispersed in water based nanoflinds

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ABSTRACT

Silver nanoparticles dispersed in water in presence of trisodium citrate have been prepared and characterised. Aqueous solutions of silver nitrate and trisodium citrate were mixed in various proportions and heated at 30°C for 3 hours. The nanoparticles of silver dispersed in water in presence trisodium citrate were characterised by UV-visible absorption spectra, X-ray diffraction, EDX, and SEM. Nano-silver dispersed in water based nanofluids may used to increase thermal conductivity of fluids.

Introduction

Nanotechnology is an emerging field through which new productions on nano scale can be manufactured. Producing a new generation of textiles which enjoy antimicrobial properties using nanoparticles has attracted a great deal of attention of the part of both scientists and consumers in recent years [1, 2]. Furthermore, metal nanoparticles show unique properties due to their peculiar electronic configuration, very large surface area and high amount of surface atoms [3]. For instance, the metal nanopartiles show a broad absorption band in the visible region of the electromagnetic spectrum [4]. Some amazing properties of metals are used in order to improved the photocatalytic activities of semiconductors such as TiO_2, SiO_2, which are among the most efficient ones resulting in higher photocatalytic properties even under visible rays [5-7]. Some noble metals such as Ag [8]. Au [9], and Pd [10, 11] have stood the test of time in the field of producing nano composites. Nano silver which is one of the outstanding nanomaterials among noble metals has wide applications in distinctive industries such as medicine, biochemistry, electrochemistry, and optic and indeed its consumption in textile industry due to obtaining antimicrobial properties is just a case in point [2, 12, 13]. Silver has been in use since time immemorial in the form of metallic silver, silver nitrate, silver sulfadiazine for the treatment of burns, wounds and several bacterial infections although its traditional applications have decreased due to the advent of antibiotics [13]. Efficiency of the nano-silver particles as well as catalytic materials depends on their structure, shape, size distribution, and chemical-physical environment; therefore, a large spectrum of research has been focused on controlling the size and shape especially on the influencing factors of silver nanoparticle formation which are crucial in their efficiency [14, 15]. Ag nanoparticles exhibit a better interaction with visible light than any other known organie or inorganic chromophore, which is due to a great density of conducting electrons [16]. Their size confinement dimensions are smaller than the mean free path, and the unique frequency dependence of the real and imaginary parts of the dielectric function in the metal collectively resulting in the existence of surface plasmon resonances (SPRs) [17]. Toxicity of silver ion and its compounds has been confirmed for bacteria and microbes; therefore, they are used in producing the would dressings [18-20] and can be applied for the manufacture of antibacterial food packaging material [21].

A new class of heat transfer fluid known as nanofluid has been developed by Choi et al. [22] and several other researchers to augment the overall heat transfer phenomena. Nonofluids are engineered stable colloidal suspension of manometric metallic/ceramic solids (particles, rods and fibers) in conventional heat transfer fluids in a small quantity (<1 vol.%) maintaining a quasi-single phase state. Thermal properties of nanofluids, as summarized by Eastman et al. [23], are characterized by many fold increase in thermal conductivity compared to that of the base fluids as a function of volume fraction of nanoparticles and temperature of the medium. This property make nanofluids a potential candidate for application in the fields of key engineering sectors like microelectronics, automobiles, power generation, transportation, aerospace and nuclear power plants.

The present work is undertaken to synthesis silvernano particles dispersed in water base nanofulid in presence of trisodium citrate and charactenise silver nanoparticles by using UV-visible spectroscopy, SEM, EDS and XRD.

Experimental

Preparation

All reagents used in this study were of analytical grade and needed no further purification. Silver-water nanofluids were prepared by wet chemical bottom up approach. 0.5 g of $AgNO_3$ was dissolved in 100ml of double distilled (DD) water. (5000

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ppm) (A).0.5 g of trisodium citrate (TSC) was dissolved in 100 ml of DD water (5000 ppm) (B). $AgNO_3$ solution (A) was the precursor solution (A) and TSC was the reducing agent (B).Various concentrations of A and B were mixed in different beakers. A(ml) + B(ml) : 1+9; 3+7; 5+5; 7+3; 9+1. The solutions in five beakers were heated in a hot air oven at 30°C for 3 hours. After three hours the solutions were allowed to cool. The solutions turned yellow due to the formation of silver nanopanticles dispersed in water in presence of trisodium citrate.

Characterization

The synthesized nanoparticles were characterized by using UV-visible absorption spectroscopy, X-ray diffraction, SEM and Energy Disperive spectro copy (EDS) UV-visible absorption spectra were recorded by using XRD pattern of AgNPs were recorded in a X-ray diffractometer (XRD_SMART/ab)-Rikgu,Japan,SEM and EDS were recorded in field Emission Scanning Electron Microscopy (FESEM-SUPRA 5S)-(ARL ZEISS,GERMANY).

For AgNPs the measurement conditions are : X-ray: 45 kV, 100mA; genometer=Smart Lab; Detector = SC-70; Scan mode=continuous; scan speed /duration time = 2.000 deg/min; step width = 0.0200 deg; scan axis = 2-Theta; scan range = 20 – 80 deg; incident slit = 1.000 nm; length limiting slit = 10.0nm; Receiving slit = 1.000 nm; Receiving slit #2 = 1.000 nm.

Results and Discussion

X-ray diffraction pattern:

X-ray diffraction pattern of pure silver nanopartilces ($AgNP_S$) have peaks at $2\Theta = 36^o, 43^o, 64^o, 77^o, 82^o$ [24].

The XRD pattern of pure trisodium citrate (TSC) is shown in fig.1. Peaks appear at $2\Theta = 25^0, 28^0, 32^0, 34^0, 42^0, 48^0$, and 56^0.

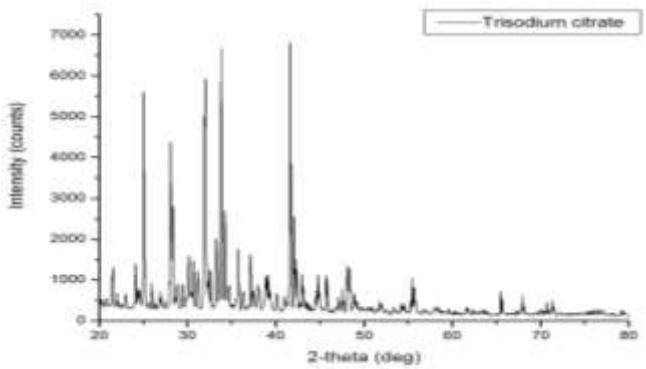

Fig 1. X ray diffraction pattern of pure Trisodiumcitrate

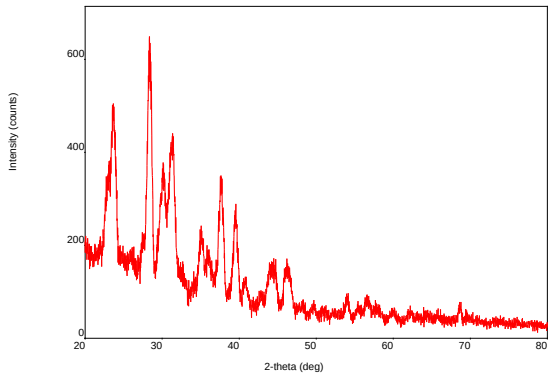

Fig2. XRD pattern of $AgNP_3$ dispersed in water in presence of TSC

The XRD pattern of AgNPd dispersed in water in presence of TSC in shown in Fig.2 Peaks appear at $2\Theta = 23^0, 27^0, 29^0, 30^0, 34^0, 38^0, 39^0, 41^0, 44^0, 47^0, 53^0, 56^0$, and 68^0. This pattern is due to the combination of AgNPs entrailed in TSC. Thus, XRD pattern confirmed the presence of AgNPs and TSC in the prepared sample. The shift in the 2Θ values of the characterstic peaks is due to the interaction between AgNP $_s$and TSC.

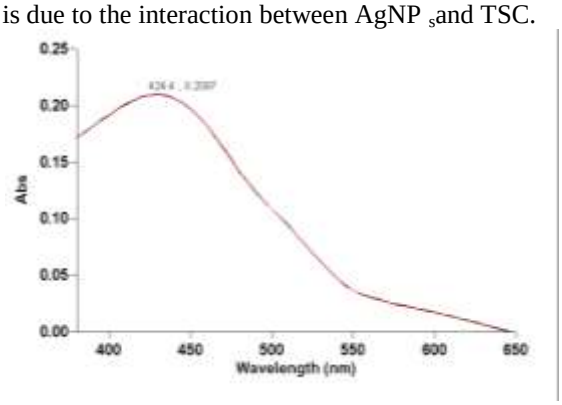

Fig 3.Uv-visible absorption spectrum of $AgNP_s$ dispersed in water in presence of TSC ($AgNo_3$ 1ml+ TSC 9ml).

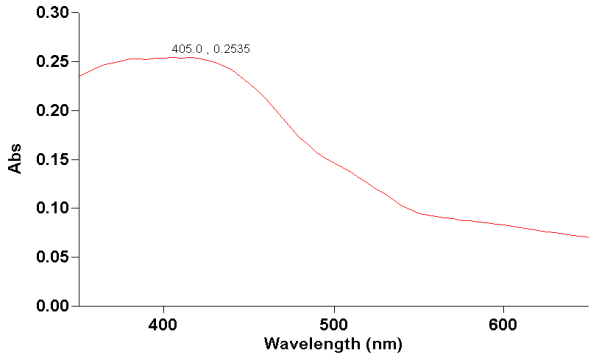

Fig 4.Uv-visible absorption spectrum of $AgNP_s$ dispersed in water in presence of TSC ($AgNo_3$ 3ml+ TSC 7ml).

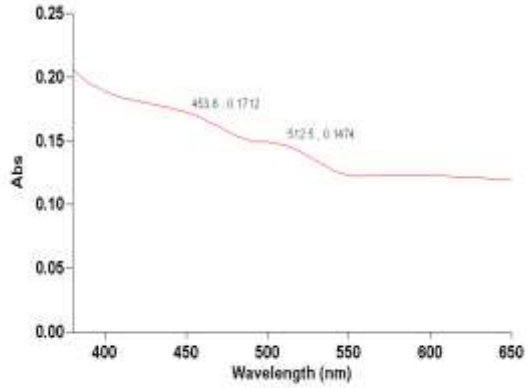

Fig5.Uv-visible absorption spectrum of $AgNP_s$ dispersed in water in presence of TSC ($AgNo_3$ 5ml+ TSC 5ml).

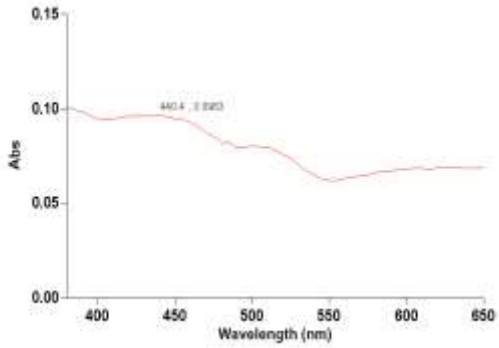

Fig6.Uv-visible absorption spectrum of $AgNP_s$ dispersed in water in presence of TSC ($AgNo_3$ 7ml+ TSC 3ml).

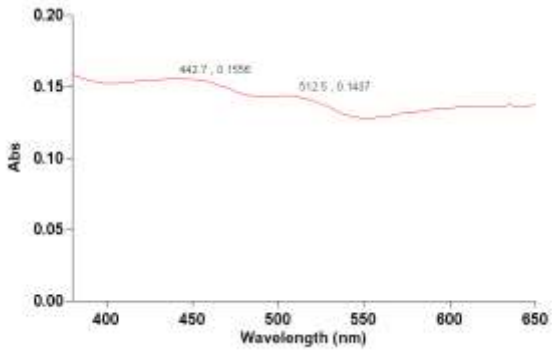

Fig7.Uv-visible absorption spectrum of $AgNP_s$ dispersed in water in presence of TSC ($AgNo_3$ 9ml+ TSC 1ml).

UV-Visible absorption spectra

The UV-visible absorption spectra of silver nanoparticles dispersed in water in presence of trisodiumcitrate and shown in fig.3-7. The five samples showed peaks at 424.4 nm; 405.0nm; 453.6 nm, 512.5nm; 440.4 nm and 442.7, 512.5 nm. Usually silver nano particles show peaks in the range 400 – 450 nm [25-28]. In the present study, depending the ratio $AgNO_3$/ TSC (ppm), there is variation in the position of the peaks of nanosoilver, dispersed in water in presence of TSC. The $AgNP_s$ showing plasmon resonance at 440.4nm ($AgNO_3$ 7ml +TSC 3ml) were selected for other studies such as XRD, SEM and EDX.

Analysis of EDS:

The nanosilver particles dispersed in water in presence of trisodium citrate were dried on a glass plate. The energy dispersive spectra of were recorded.

The spectra are shown in figs(8) and (9). The data derived from the spectra are given in Table1. The processing option during recording the spectrum was normalised (all elements were analysed). The number of iteration was 3. The following standards were used: carbon – $CaCO_3$; oxygen – SiO_2; sodium – Albite; Silver – Ag.

Fig.8.EDS spectrum of the silver nanoparticles

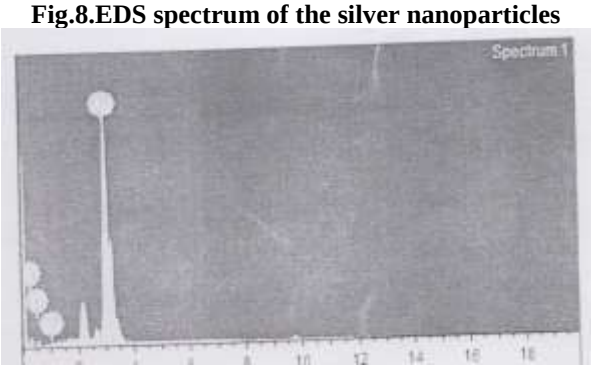

Fig.9. EDS spectrum of the silver nanoparticles

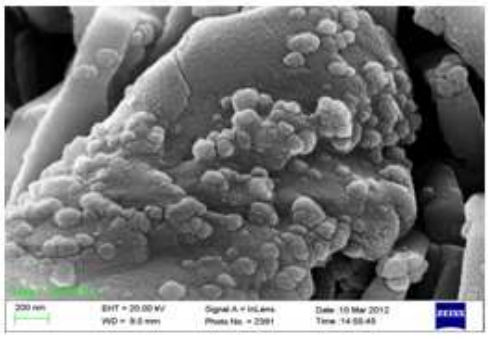

Fig. 10

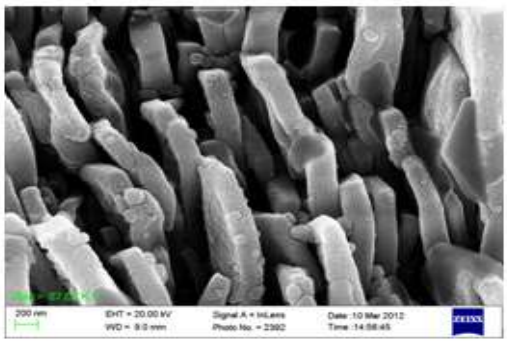

Fig. 11

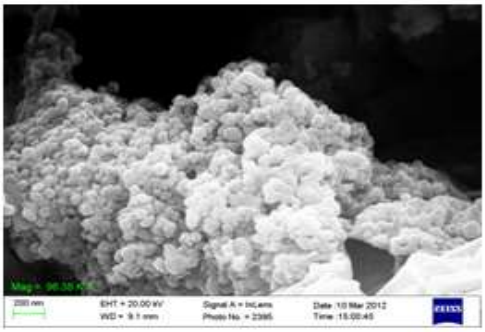

Fig. 12

Table : Date derived from EDS

Element	Weight %	Atomic %
CK	3.11	14.74
OK	11.00	39.14
Na K	0.40	0.99
Ag L	85.49	45.13
Total	100.00	

It is observed from Table1 that film formed on the surface of the glan plate consists of 85.49% silver (nanoparticls) 0.40% sodium (from trisodium cirtrate, TSC), 11.00% Oxygen (from TSC) and 3.11% Carbon (from TSC). The average size of the nanoparticle was 40 nm. The silver nanoparticles are seen in fig.8. They are entrailed in TSC platelets.

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