Sangeeta Tantubay

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Academic

Qualification	University/Board	Year of Passing	Percentage
Pursuing Ph.D. in Chemistry (Synthesis of Nanomaterials and Study of their Application)	Department of Chemistry, Indian Institute of Technology Kharagpur	2012 (January) to 2019 (till date), Thesis submitted	…….
M.Sc. Chemistry (Organic Specialization)	The University Of Burdwan	2011	72.33%
B.Sc. Chemistry (Three year Honours Degree course)	The University Of Burdwan	2009	68.25%
Class 12th	West Bengal Council Of Higher Secondary Education	2006	81.1%
Class 10th	West Bengal Board Of Secondary Education	2004	88.75%

ALL INDIA EXAMINATIONS QUALIFIED

- CSIR-UGC NET (June-2011): **UGC, All India Rank-89**
- CSIR-UGC NET (December-2010): **LS**

Research and Teaching Experience

- Doctorial research in synthesis and characterization of plasmonic metal-based nanomaterials for sensing, catalysis and antimicrobial applications.
- Taken Physical Chemistry tutorial classes (for two semesters) and laboratory classes (for two semesters) of 1st year undergraduate (B.Tech) students in IIT Kharagpur.
- Taken Physical Chemistry practical classes (for one semester) of M.Sc. 1st year students in IIT Kharagpur.
- Taken Organic Chemistry classes (for one month) of B.Sc. Chemistry (Three year Honours Degree course) students in Raghunathpur College (Sidho Kanho Birsha University).

Achievement

- Received Fellowship for Ph.D from University Grants Commission, New Delhi, India (2012-2016)

Major Courses Undertaken

Doctor of Philosophy (Ph.D.) Course Work

English for technical writing, German, organic photochemistry and pericyclic reactions, biophysical chemistry, applications of metal complexes in catalysis & material science, supramolecular chemistry, applications of fluorescence spectroscopy in chemistry & biology, introduction to nanotechnology & nano-structured materials.

Master of Science (M.Sc.)

Chemistry (Organic Specialization)

Bachelor of Science (B.Sc.)

Chemistry (Honours), Physics, Mathematics, Bengali, English, Environmental Science

Languages Known

English, Hindi, Bengali, and 6 months basic course in German.

Knowledge in Material Characterization

- X-Ray diffraction (XRD)
- X-ray photoelectron spectroscopy (XPS)
- Zeta-potential measurement

- Hydrodynamic radius measurement
- UV-Vis spectroscopy
- Fluorescence spectroscopy
- Thermogravimetric analysis (TGA)
- Differential Thermal Analysis (DTA)
- Transmission electron microscopy (TGA)
- Field emission scanning electron microscopy (FESEM)
- Fourier-transform infrared spectroscopy (FTIR)
- Atomic force microscopy (AFM)
- Brunauer–Emmett–Teller (BET) measurement
- Small angle X-ray scattering (SAXS)
- Electron paramagnetic resonance (EPR) spectroscopy
- Nuclear Magnetic Resonance (NMR) spectroscopy
- Mass spectroscopy
- Cell cytotoxicity test (MTT assay)

Instrument Handled

UV-Vis Spectrophotometer, Fluorometer, Particle size analyser (DLS & Zeta measurements) and High Performance Liquid Chromatography (HPLC)

List of Publications

1. **Tantubay, S.**; Mukhopadhyay, S. K.; Kalita, H.; Konar, S.; Dey, S.; Pathak, A.; Panchanan, P. Carboxymethylated chitosan-stabilized copper nanoparticles: a promise to contribute a potent antifungal and antibacterial agent. *Journal of Nanoparticle Research*, **2015**, 17, 243.

2. Kalita, H.; Konar, S.; **Tantubay, S.**; Mahto, M. K.; Pathak, A. Phase transformation in Mn-doped titania hollow spheres and their biocompatibility studies. *Applied Nanoscience*, **2015**, 5, 901-910.

3. Kalita, H.; Kumar, B. N. P.; Konar, S.; **Tantubay, S.**; Mahto, M. K.; Mandal, M.; Pathak, A. Sonochemically synthesized biocompatible zirconium phosphate nanoparticles for pH sensitive drug delivery application. *Materials Science and Engineering C*, **2016**, 60, 84-91.

4. Konar, S.; Kalita, H.; Puvvada, N.; **Tantubay, S.**; Mahto, M. K.; Biswas, S.; Pathak, A. Shape-dependent catalytic activity of CuO nanostructures. *Journal of Catalysis*, **2016**, 336, 11-22.

Research Interest

Synthesis and characterization of various metal and metal oxide nanomaterials and appraisal of their applicability in various fields such as sensing, catalysis, antimicrobial studies, etc.

Workshop Attended

- Attended the one day Workshop on “Towards Smart Functional Materials: An Interdisciplinary Approach” organized by Department of Chemistry, IIT Kharagpur, India on 19th March 2019.
- Attended the two days Workshop on “Rietveld Analysis – Application Training” organized by the XRD Lab, Metallurgical & Materials Engineering, IIT Kharagpur Indian Institute of Metals (IIM) Kharagpur Chapter Central Research Facility (CRF), IIT Kharagpur on 14th and 15th March 2019.
- Attended the half day Workshop on “SCHOLARLY PUBLISHING” organized by Central Library, IIT Kharagpur in association with Wiley India Pvt. Ltd on 23rd March 2015.

Poster Presented

- Poster Presentation at the “Recent Advances in Functional Inorganic & Nanomaterials Chemistry (RAFINC-2017)” organized by Department of Chemistry, IIT Kharagpur, India on 11th November 2017.
- Poster Presentation at the “Light in Chemistry, Materials and Biology (LCMB – 2014)” organized by Department of Chemistry, IIT Kharagpur, India on 24th February 2014.

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DOI 10.1007/s11051-015-3047-9

RESEARCH PAPER

Carboxymethylated chitosan-stabilized copper nanoparticles: a promise to contribute a potent antifungal and antibacterial agent

Sangeeta Tantubay · Sourav K. Mukhopadhyay · Himani Kalita · Suraj Konar · Satyahari Dey · Amita Pathak · Panchanan Pramanik

Received: 13 January 2015 / Accepted: 20 May 2015 / Published online: 2 June 2015

Abstract Carboxymethylated chitosan (CMC)-stabilized copper nanoparticles (Cu-NPs) have been synthesized via chemical reduction of copper(II)–CMC complex in aqueous medium by hydrazine under microwave irradiation in ambient atmosphere. Structural morphology, phase, and chemical compositions of CMC-stabilized Cu-NPs (CMC–Cu-NPs) have been analyzed through high-resolution transmission electron microscopy, field emission scanning electron microscopy, X-ray diffraction, and X-ray photoelectron spectroscopy. Antifungal and antibacterial activities of CMC–Cu-NPs have been evaluated against *Candida tropicalis* and *Escherichia coli* through agar well diffusion method, broth microdilution assay, live–dead assay, and microscopic observation. Antimicrobial activity of spherical CMC–Cu-NPs ($\sim$4–15 nm of diameters) has been observed to be significant for both *C. tropicalis* and *E. coli*. The cytotoxicity study indicates that CMC–Cu-NPs have no significant toxic effect against normal cell line, L929.

Keywords Copper nanoparticles (Cu-NPs) · Carboxymethylated chitosan (CMC) · Antifungal · Antibacterial · *C. tropicalis* · *E. coli* · Toxicity study

Electronic supplementary material The online version of this article (doi:10.1007/s11051-015-3047-9) contains supplementary material, which is available to authorized users.

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Introduction

Fungal infections are one of the major causes of global morbidity and mortality, particularly for the patients with weakened immune systems, such as people suffering from acquired immune deficiency syndrome (AIDS) or those subjected to repetitive treatment with antibiotics and chemotherapeutic agents with immunosuppressive activity (Cioffi et al. 2005). The global menace of microbial resistances to common antibiotics (Kyriacou et al. 2004) has led researchers to focus on the development of alternate therapeutic methodology for overcoming these difficulties faced by mankind today. In this regard, use of metal nanoparticles (MNPs) has gained significant relevance since metals and their complexes have been used for their antimicrobial properties for centuries. Small size

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ORIGINAL ARTICLE

Phase transformation in Mn-doped titania hollow spheres and their biocompatibility studies

Himani Kalita · Suraj Konar · Sangeeta Tantubay · Madhusudan Kr. Mahto · Amita Pathak

Received: 13 November 2014 / Accepted: 19 January 2015 / Published online: 31 January 2015

Abstract Mn-doped titania hollow nanospheres were prepared via sacrificial core templating method at room temperature, using carbon spheres as the sacrificial core and template. X-ray diffraction and thermal studies showed the phase transformation of titania from anatase to rutile at temperature as low as 550 °C, when the dopant (i.e., Mn) concentration was increased from 1 to 6 mol % (with respect to Ti). Fourier transform infra red spectroscopic studies have been carried out to determine the surface functional groups, while the spherical and hollow morphology of the titania nanostructures have been confirmed through scanning electron microscopic as well as transmission electron microscopic studies. The chemical composition of the samples has been determined through X-ray photoelectron spectroscopic studies, while their magnetic properties have been studied using superconducting quantum interference device analysis. The biocompatibility and suitability of the nanospheres for intracellular applications has been tested through conventional MTT assay using MDA-MB 231 human breast cancer cell lines.

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Keywords Mn-doped · Titania · Hollow spheres · Anatase · Rutile · Biocompatibility

Introduction

Recently, there has been a surge of research interest in developing appropriate inorganic nanostructures for different biomedical applications. Various nanostructures of hydroxyapatite (Andronescu et al. 2013; Venkatesan et al. 2011; Wang et al. 2009), magnetite (Daumann et al. 2014; Dorniani et al. 2013), zirconia (Batra et al. 2013; Tang et al. 2010), titania (Hou et al. 2014; Aw et al. 2012), silica (Bernal et al. 2014; Xu et al. 2013) etc., have already gained attention due to their efficacy in the fabrication of biosensors and nanocarriers for targeted delivery of drugs as well as substrates for immobilization of biomolecules. Among the various inorganic materials, titania (TiO_2) holds great promise in biomedical applications owing to its wide availability, biological as well as chemical inertness and have so far been reported in various morphological forms such as nanoparticles (Liang et al. 2013), nanorods (Pang et al. 2013), nanowires (Sun and Wu 2013), nanosheets (Liu et al. 2013), nanotubes (Pandikumar and Ramaraj 2013), mesopores (Mascolo 2013), and hollow spheres (Zhao and Middelberg 2013). However, all literature reports on biomedical applications using titania based nanomaterials have been performed using titania (TiO_2) films (Kim et al. 2010), mesoporous nanoparticles (Wu et al. 2011), and nanotubes (Aw et al. 2012; Gulati et al. 2012). The hollow nanostructured titania (or, doped titania), which have the potential to create a whole new generation in host–guest chemistry because of their low density, high surface area, tunable pore structure and good surface

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Sonochemically synthesized biocompatible zirconium phosphate nanoparticles for pH sensitive drug delivery application

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ABSTRACT

The present work reports the synthesis of biocompatible zirconium phosphate (ZP) nanoparticles as nanocarrier for drug delivery application. The ZP nanoparticles were synthesized via a simple sonochemical method in the presence of cetyltrimethylammonium bromide and their efficacy for the delivery of drugs has been tested through various in-vitro experiments. The particle size and BET surface area of the nanoparticles were found to be ~48 nm and 206.51 m^2/g respectively. The conventional MTT assay and cellular localization studies of the particles, performed on MDA-MB-231 cell lines, demonstrate their excellent biocompatibility and cellular internalization behavior. The loading of curcumin, an antitumor drug, onto the ZP nanoparticles shows the rapid drug uptake ability of the particles, while the drug release study, performed at two different pH values (at 7.4 and 5) depicts pH sensitive release-profile. The MTT assay and cellular localization studies revealed higher cellular inhibition and better bioavailability of the nanoformulated curcumin compared to free curcumin.

1. Introduction

Over the last few decades, the development of nanoparticle assisted drug delivery systems that can circumvent the toxic effects of drug over dose and overcome the limitations of inadequate drug concentration at the affected sites has gained a surge of interest in the area of controlled delivery of drugs. Some of the materials that have gained attention in this area include zirconia [1–2], hydroxyapatite [3–5], titania [6–9], silica [10–13], zirconium phosphate [14–15], magnetite [16–20] etc. Among the materials, zirconium phosphate (ZP) is one of the most promising candidate for drug delivery application owing to its excellent biocompatibility, high thermal stability, wide availability and good chemical as well as biological inertness. Additionally, ZP is reported to dissociate into phosphate ions and non-toxic zirconium salts in the presence of lysosome and peroxisomes in the biological systems [21], which can be easily absorbed or eliminated from the body. In fact, layered ZPs (α-ZP and θ-ZP) in the form of nanoplatelets and nanosheets have already been reported as carriers for the delivery of drugs [14–15,21] and hormones [22]. They are also reported for the immobilization of enzymes [23] and binding of proteins [24]. However, almost no literature report is available on the usage of crystalline nanoparticles of ZP as nanocarrier for the delivery of drug molecules till date, to the best of our knowledge. This is despite the fact that the crystalline nanoparticles of ZP, by virtue of their small size and high surface to volume ratio, are likely to act as an efficient nanocarrier for drug delivery. Moreover, there are only few reports available on the synthesis of ZP nanoparticles (NPs) which includes the solvothermal [25], chemical precipitation [26] and water-in-oil microemulsion routes [27].

The aim of the present study is, therefore, focused on establishing a simple methodology for the preparation of ZP NPs and to test their efficacy as nanocarrier for drug delivery application. The ZP NPs were synthesized via a simple sonochemical approach at ambient temperature (25 ± 1 °C) using zirconium oxychloride and orthophosphoric acid as the precursors for zirconium and phosphate respectively in the presence of cetyltrimethylammonium bromide (CTAB). The suitability of the prepared particles as nanocarrier for the delivery of drugs has been tested by the conventional MTT assay and cellular uptake studies using MDA-MB-231 cell lines. The drug loading and releasing efficiency of the NPs has been studied through in-vitro experiments using curcumin ((1E,6E)-1,7-Bis(4-hydroxy-3-methoxyphenyl)-1,6-heptadiene-3,5-dione) as the model drug, which is reported to exhibit anti-inflammatory, antioxidant and anti-tumor properties. The cytotoxicity and cellular internalization behavior of the nanoformulated curcumin was also tested through MTT assay and cellular uptake studies using MDA-MB-231 cell lines.

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Shape-dependent catalytic activity of CuO nanostructures

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$NaBH_4$

ABSTRACT

Ligand-regulated growth of various morphologies of copper oxide (CuO) nanostructures has been achieved through an aqueous-based chemical precipitation route where the Cu^{2+} ions were stabilized through complexation with different organic acids (viz. acetic/citric/tartaric acid). The rod-, spherical-, star-, and flower-shaped morphologies of the CuO nanostructures, obtained in the presence of the different carboxylic acids, have been characterized using XRD, FTIR, HRTEM, DLS, and zeta potential measurements, while their specific surface areas and the associated band gap energies have been compared. The catalytic performance of the different CuO nanostructures has been affirmed by monitoring the reduction of 4-nitrophenol by $NaBH_4$ in real time using UV–visible absorption spectroscopy. The star-shaped morphologies of CuO have been found to show maximum catalytic activity toward the reduction of 4-nitrophenol in the presence of $NaBH_4$, which can be correlated to their higher specific surface area and positive surface charge and to the presence of a high indexed facet.

1. Introduction

Controlled synthesis of metal oxide nanostructures with various shapes and sizes is of great importance in the field of nanotechnology, since each of their technological applications entails specific physicochemical properties, which can only be associated with a certain morphology. The morphology-modulated properties acquired by controlling the crystalline structure, usually endowed with a higher surface-to-volume ratio and crystallographic facet features, have stimulated researchers to pursue diverse morphologies of metal oxide nanostructures. The size- and morphology-modulated properties are particularly significant in availing their surface-sensitive applications, such as in the field of heterogeneous catalysis [1], in the fabrication of photoelectrochemical cells [2] and batteries [3], in gas sensors [4], and as antibacterial agents [5].

Morphology-dependent superior catalytic performance shown by certain metal oxide nanostructures [6] is an immense contribution in the industry; thus, their study is of great societal relevance as well. CuO is one such transition metal oxide system, which is reported to illustrate significant size- and morphology-dependent catalytic activity. For example, Zhou et al. reported that the oxidation of CO [7] can be catalyzed by CuO nanobelts and nanoplatelets. Another widely studied and industrially relevant model reaction that is used for evaluating the catalytic efficacy of the various CuO morphologies in aqueous medium is the synthesis of 4-aminophenol (4-AP), an important intermediate in the production of various analgesic and antipyretic drugs, via hydrogenation of 4-nitrophenol (4-NP) using an excess of sodium borohydride ($NaBH_4$). It has been well documented that the reduction of 4-NP, which is a toxic chemical typically found in industrial waste and a contaminant in agricultural waste waters, can be catalyzed by various metal [8,9] and metal oxide [10,11] nanoparticles in aqueous medium, and the color change associated with the reduction reaction provides a basis for monitoring the reaction kinetics. Studying this model reaction, Pande and Pal [12] and Zhou et al. [13] reported the catalytic behavior shown by nanoboxes and cellulose-nanocrystal-supported nanospheres of CuO, respectively. Tamuly et al. [14] have shown that biogenically synthesized spherical and oval CuO nanoparticles, self-assembled to form flowerlike nanostructures, can catalyze the reduction of several nitro aryl compounds to their respective amino compounds. Mandlimath and Gopal [15] and Nasrollahzadeh et al. [16] have also reported the reduction of 4-NP using spherical CuO nanoparticles as catalysts. Thus, catalytic propertied offered by different morphologies of CuO nanostructures are reported in the literature. However, there are only few reports that have attempted to understand the growth mechanism of the different morphological forms of CuO nanostructures and have also tried to correlate it with their catalytic performance. Although in a recent report, Che et al. [17] have studied leaf-, flower-, and dumbbell-shaped CuO nanostructures and have correlated the different shapes with their catalytic performance in

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