



NANOMATERIALS MEETINGS 2017

ACCEPTED ABSTRACTS

INTERNATIONAL MEETING ON
ADVANCED NANOMATERIALS AND NANOTECHNOLOGY
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Heterogenous graphene supported cobalt metal catalyzed dehydrogenation of N-heterocycles

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The promoterless AD (acceptorless dehydrogenation) reaction with the release of H₂ provides promising synthetic routes for several organic transformation such as alcohol dehydrogenation to carbonyl compounds as aldehydes, ketones, esters, amides, amine to imine and N- heterocycles dehydrogenation which is synthetically very important. Dehydrogenation of N-heterocycles were mediated by cobalt heterogenous has been done at atmospheric condition with the liberation of hydrogen which is most atom efficient way to produce quinoline.

Owing to the increasing demand for environmentally benign synthetic processes, promoterless AAD reactions are desirable. Conventionally, oxidative dehydrogenation reaction has been performed using stoichiometric or excess amounts of oxidants such as DDQ, peroxides, iodates, chromium(IV) reagents and metal oxides, that produce large excess of hazardous waste equivalent to the oxidants which is undesirable environmentally and economically. An alternative to these strong and toxic oxidants is to use pressurized oxygen air or oxygen which can cause explosion hazards. Removal of dihydrogen atoms from adjacent atomic centers of organic molecule is highly thermodynamically uphill process. Thus, it would be challenging to explore the catalytic performance of heterogenous catalysts for the dehydrogenation of nitrogen heterocycles.

Our interest is in the development of efficient heterogeneous catalyst containing sustainable transition metals, such cobalt for the dehydrogenation reaction. we have propose first cobalt based heterogenous catalytic system for challanging catalytic dehydrogenation reactions of nitrogen heterocycles. In this reaction only hydrogen is side product which is good in the context of 'hydrogen economy' and is an effective alternative to the classical oxidation reactions

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Phospholipid stabilized gold nanorods: Towards improved colloidal stability and biocompatibility

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Biocompatible and colloidally stable gold nanorods (GNRs) of well-defined plasmonic properties are essential for biomedical and ther-anostic applications. The as-synthesized GNRs in the seed-mediated method are stabilized by cetyltrimethylammonium bromide (CTAB) surfactant, which is known for its cytotoxicity in many cell lines. Bio-compatible GNRs synthesized from known protocols exhibit some extent of cytotoxicity and colloidal instability because of incomplete removal of CTAB. We report a facile method for the efficient re-moval of CTAB molecules with 1,2-dimyristoyl-sn-glycero-3-phos-phocholine (DMPC) phospholipids, which are naturally present in cell membranes. The ligand exchange kinetics is studied using surface-enhanced Raman scattering (SERS) and corroborated with matrix assisted laser desorption/ionization (MALDI) mass spectrometry. From colloidal stability studies using dynamic light scattering (DLS) and UV-Vis spectroscopy, the optimal lipid concentration and dura-tion required for successful ligand exchange of CTAB by DMPC are reported. Using thermogravimetric analysis, the surface concentra-tion of DMPC on colloidally stable GNRs is found to be approxi-mately 9 molecules per nm². The 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) and lactate dehydrogenase (LDH) assays show that the surface modified DMPC-GNRs have significantly better biocompatibility compared to CTAB-GNRs. Stud-ies on ligand exchange, colloidal stability and biocompatibility of DMPC-GNRs of aspect ratios in the range of 2.2 - 4.2 demonstrate the robustness of the proposed method. The results provide insight on the important factors to be considered to design biocompatible GNRs suitable for applications in nanomedicine.

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Engineering nanomaterials: Biomedical applications with nanotoxicological perspectives

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State-of-the-art nanomaterials are at the forefront in emergent arenas of nanotechnology and nanomedicine. Controlled synthesis, unique tunable properties and tranquil surface modification with chemical or biological moieties make engineered nanomaterials appropriate for a variety of biomedical applications. Moreover, designer made nanomaterials display distinctive therapeutic potentials with improved sensitivity, efficiency and specificity and these are due to modified distinctive physicochemical and surface properties of nanomaterials. In addition to above, the designer made nanomaterials has prospective to produce a series of interactions with different biological entities including DNA, proteins, membranes, cells and organelles. Such nano-bio interfacial communications are motivated by colloidal forces and primarily depend on the dynamic physicochemical and surface properties of particular nanomaterial. Nonetheless, contemporary progress and atomic scale tailoring of various physical, chemical and surface characteristics of nanomaterial is promising to dictate their interactions in expected manner with biological units for biomedical applications. Therefore, wisely designed nanomaterials are in extensive demand for a range of applications such as bio-molecular detection and diagnostics, therapeutics, drug and gene delivery, fluorescent labeling, tissue engineering, biochemical sensing and other pharmaceuticals applications. Conversely, the toxicity and hazards concomitant with engineered nanomaterials is rather vague or not well understood. This sort of concerns is gaining considerable attention and the field of nanotoxicology is progressing quickly. Therefore, in this overview lecture, author will reconnoiter current knowledge of articulate engineering of nanomaterials for biomedical applications with special attention on their potential toxicological perspectives.

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Near-infrared optogenetic activation of channel rhodopsin expressed in living cells via upconverting nanoparticles with target specificity

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Optogenetics is an innovative technology now widely adopted by researchers in different fields of the biological sciences. However, most proteins adopted in optogenetics are excited by ultra-violet or visible light that has a weak tissue penetration capability. Upconverting nanoparticles (UCNPs), which transform near-infrared (NIR) light to short-wavelength emission, can help address this issue. To improve optogenetic performance, we enhance the target selectivity for optogenetic controls by specifically conjugating the UCNPs with light-sensitive proteins at a molecular level, which shortens the distance as well as enhances the efficiency of energy transfer. We tagged V5 epitope to the extracellular N-terminal of channelrhodopsin-2 with a mCherry conjugated at the intracellular C-terminal (V5-ChR2m) and then bound NeutrAvidin-functionalized UCNPs (NAv-UCNPs) to the V5-ChR2m via a biotinylated antibody against V5. The results showed NAv-UCNPs bound to the plasma membranes of cells expressing V5-ChR2m, but not ChR2m without the V5 epitope. Under NIR illumination, the NIR-upconverted blue illumination from UCNP induced an inward cation current and elevated the intracellular Ca^{2+} concentration in the live cells expressing V5-ChR2m bound with NAv-UCNPs. The fluorescence resonance energy transfer (FRET) from the excited UCNP to the V5-ChR2m was confirmed by fluorescence lifetime imaging measurements. Our results demonstrate that when membrane channelrhodopsin is specifically anchored by UCNPs in the molecular level, the energy transfer via irradiance and FRET can greatly enhance the optogenetic performance.

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Control of mesoporous silica nanoparticles physicochemical properties through control of synthetic parameter using Box-Behnken design

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Statement of the Problem: Mesoporous silica nanoparticles (MSN) have been utilized in drug delivery due to their controllable release kinetics. The control of the physicochemical properties of nanoparticles for applications is stated to be complex despite the use of computational model. The pH, molar ratio of silica source and water and calcination temperature impact in drug delivery has not been studied before. Understanding of these critical synthetic parameters can aid in controlling the particle size, pore structure and size, surface chemistry and drug loading capacity.

Methodology & Theoretical Orientation: Box-Behnken design was utilized for evaluation of these parameters. Whereby, post-grafting of amine, surface chemistry post calcination, drug loading particle size and pore's structure was studied. For application in drug delivery, rifampicin was loaded into the particles followed by capping with pH responsive chitosan.

Findings: Based on the surface response plot from the experimental design, the size of the particle indicates to be dependent on the amount of water available for hydrolysis and dissolution to occur at a near neutral pH. The highest size obtained was 609 ± 44.44 (n=3), whereby pH 8 and molar ratio of 126 was used. The smallest size was observed was observed at pH 12. The calcination temperature played a role in condensation of the free silanols which lead to changes in the grafting potential of the silica surface to (3-Aminopropyl) triethoxysilane. The amount of drug entrapped indicates can be improves though increase in particle size and increase in the porous particle structure.

Conclusion & Significance: This works adds to previous work that indicates that TEOS: water ratio plays a role in particle size, pH plays a role in the control of the network structure, whilst calcination temperature affects the degree of post synthesis silanol condensation.

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Role of gold nanorods: Inhibition and dissolution of $A\beta$ fibrils induced by near IR laser

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Extracellular plaques of amyloid beta ($A\beta$) fibrils and neurofibrillary tangles are known to be associated with neurological diseases such as Alzheimer's disease. Studies have shown that spherical nanoparticles inhibit the formation of $A\beta$ fibrils by intercepting the nucleation and growth pathways of fibrillation. In this report, gold nanorods (AuNRs) are used to inhibit the formation of $A\beta$ fibrils and the shape-dependent plasmonic properties of AuNRs are exploited to facilitate faster dissolution of mature $A\beta$ fibrils. Negatively charged, lipid (DMPC) stabilized AuNRs inhibit the formation of fibrils due to selective binding to the positively charged amyloidogenic sequence of $A\beta$ protein. The kinetics of inhibition is characterized by thioflavin T (ThT) fluorescence, transmission electronic microscopy (TEM), atomic force microscopy (AFM), and attenuated total reflectance Fourier transform infrared spectroscopy (ATR-FTIR). An increase in the aspect ratio of DMPC-AuNR in the range of 2.2-4.2 decreased the fibrils content proportionally. Further, the fibrils content is decreased by increasing the concentration of AuNR for all aspect ratios. As AuNR absorb near-infrared (NIR) light and creates a localized hotspot, NIR laser (800 nm) is applied for 2 min to facilitate the thermal dissolution of mature $A\beta$ fibrils. Majority of $A\beta$ fibrils are disintegrated into smaller fragments after exposure to NIR in the presence of AuNR. Thus, the DMPC-AuNRs exhibit a dual effect: inhibition of fibrillation and NIR laser facilitated dissolution of mature amyloid fibrils. This study essentially provides guidelines to design efficient nanoparticle-based therapeutics for neurodegenerative diseases.

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Energy efficient for heat exchanger, refrigeration and air conditioning

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Globally, buildings are responsible for approximately 40% of the total world annual energy consumption. Most of this energy is for the provision of lighting, heating, cooling, and air conditioning. Increasing awareness of the environmental impact of CO₂, NO_x and CFCs emissions triggered a renewed interest in environmentally friendly cooling, and heating technologies. Under the 1997 Montreal Protocol, governments agreed to phase out chemicals used as refrigerants that have the potential to destroy stratospheric ozone. It was therefore considered desirable to reduce energy consumption and decrease the rate of depletion of world energy reserves and pollution of the environment. This article discusses a comprehensive review of energy sources, environment and sustainable development. This includes all the renewable energy technologies, energy efficiency systems, energy conservation scenarios, energy savings and other mitigation measures necessary to reduce climate change.

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Influence of grain size and grain boundary interface on the electrical properties of oxide nanocrystals under biased conditions

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Nanocrystalline CuO, CeO₂ and TiO₂ with various grain sizes were prepared by wet chemical methods such as precipitation and sol-gel process by tuning the various parameters during the course of reaction or post-processing procedures. Carrier transport through electrically active grain boundaries was studied under biased condition using impedance spectroscopy at room temperature were performed using Solartron (SI 1260) impedance/gain phase analyzer in the frequency range of 1 Hz to 1 MHz with platinum electrodes. To perform the impedance measurement, cylindrical pellets having 8 mm diameter and ~1 mm thickness were made by applying two ton uni-axial pressure to all the samples and sintered at the appropriate temperatures. After doing the impedance measurement, the pellets were crushed to get powders and characterized using Philips CM20 Transmission electron microscope (TEM) to study then grain size distribution and morphology. The observed grain size effect on voltage tunable dielectric constant behaviour obeys the “double Schottky grain boundary potential barrier height model”, these experimental results will be discussed in detail.

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