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Short Communication

Biomimetic structures and materials for energy absorption

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Abstract

The need to carry out research focused on novel ecological protocols has increased exponentially, motivated by the common aim to reduce toxic by-products drawback from chemical and physical methods. Amongst different living organisms studied as potential candidates for the synthesis of metallic nanoparticles, algae biomass is presented as a novel and easy-to-handle. We evaluate the influence of reaction parameters in the synthesis of copper nanoparticles (Cu-NPs) using Macrocystis pyrifera free-biomass non-boiled (FBNB) extract. Response surface methodology (RSM) based on a central composite design (CCD) was used to evaluate the following independent variables for nanoparticle formation in the extract: X1: CuSO4 concentration; X2: pH; and X3: temperature. Their effects were assessed on synthesized Cu-NP average size distribution, zeta potential, and polydispersity index (PDI) by dynamic light scattering (DLS). Shape, size, and elemental mapping at a microstructural level were measured by scanning electron microscopy (SEM) with energy dispersive X-ray spectrometry (EDS). Results from CCD showed that predicted optimal reaction conditions for Cu-NP formation using M. pyrifera extract were 2.2 mM CuSO4 concentration, pH 8, and incubation at 25,5°C, obtaining an average size distribution, Z potential and PDI of 121 nm, -23.5 mV and 0.3, respectively. This work demonstrated that M. pyrifera extract is a feasible biomass for the synthesis of Cu-NPs and that the control of the reaction parameters can determine the nanoparticle characteristics..

Biography:

Dr Ha has acquired extensive research experience and expertise in biological materials, bio-inspired structures, structural design, energy absorption, impact mechanics and application of the digital image correlation technique. He developed several advanced experimental techniques as well as numerous numerical models to investigate the mechanical properties and behaviour of biological materials under static and dynamic condition. His past and on-going research works span across several subjects in protective biological materials such as protective beetle forewing, durian skin and in numerical modelling for a variety of bio-inspired structures to investigate their energy absorption characteristics, such as bio-inspired corrugated tube mimicking the coconut configuration, bio-inspired corrugated honeycomb core sandwich panel, bio-inspired multi-cell structures, bio-inspired multi-layer graded foam-filled structures. Through his research, Dr Ha aims to advance our understanding of underlying biological structural design that can create an effective guideline for the design of high-performance bio-inspired structures for many real-life engineering applications.

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