World Academy of Science, Engineering and Technology
International Journal of Marine and Environmental Sciences
Vol:11, No:07, 2017

Crab Shell Waste Chitosan-Based Thin Film for Acoustic Sensor Applications

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Abstract : Industrial waste of crustacean shells, such as shrimp and crab, has been considered as one of the major issues contributing to environmental pollution. The waste processing mechanisms to form new, practical substances with added value have been developed. Chitosan, a derived matter from chitin, which is obtained from crab and shrimp shells, performs prodigiously in broad range applications. A chitosan composite-based diaphragm is a new inspiration in fiber optic acoustic sensor advancement. Elastic modulus, dynamic response, and sensitivity to acoustic wave of chitosan-based composite film contribute great potentials of organic-based sound-detecting material. The objective of this research was to develop chitosan diaphragm application in fiber optic microphone system. The formulation was conducted by blending 5% polyvinyl alcohol (PVA) solution with dissolved chitosan at 0%, 1% and 2% in 1:1 ratio, respectively. Composite diaphragms were characterized for the morphological and mechanical properties to predict the desired acoustic sensor sensitivity. The composite with 2% chitosan indicated optimum performance with 242.55 µm thickness, 67.9% relative humidity, and 29-76% light transmittance. The Young's modulus of 2%-chitosan composite material was 4.89×104 N/m2, which generated the voltage amplitude of 0.013V and performed sensitivity of 3.28 mV/Pa at 1 kHz. Based on the results above, chitosan from crustacean shell waste can be considered as a viable alternative material for fiber optic acoustic sensor sensing pad development. Further, the research in chitosan utilisation is proposed as novel optical microphone development in anthropogenic noise controlling effort for environmental and biodiversity conservation.

Keywords : acoustic sensor, chitosan, composite, crab shell, diaphragm, waste utilisation
Conference Title : ICASF 2017 : International Conference on Aquatic Sciences and Fisheries
Conference Location : London, United Kingdom
Conference Dates : July 24-25, 2017