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Biopolymer Chitosan Based Monopole Antenna for Hybrid Piezoelectric-RF Energy Harvester Applications

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Abstract

This paper presents the design, simulation, and experimental evaluation of a monopole antenna fabricated on a biocompatible chitosan substrate. The use of chitosan, a natural biopolymer with its piezoelectric capability, enables environmentally friendly hybrid piezoelectric-radio frequency energy harvesters. A monopole antenna operating at frequency of 2.4 GHz was designed and simulated using ANSYS HFSS. The prototype was fabricated using a chitosan film prepared through a

solution casting method. The performance of the proposed antenna was validated through its return loss and radiation patterns. Results show good impedance matching performance at 2.4 GHz with simulated and measured reflection coefficient values of 10.7 dB and 13.9 dB respectively. The simulated peak gain of the antenna is 2.3 dBi. The study demonstrates the potential of chitosan-based substrates in developing hybrid piezoelectric-RF energy harvesters. ©2025 IEEE.

Author keywords

biopolymer; chitosan substrate; Monopole antenna; piezoelectric

Indexed keywords

Engineering controlled terms

Biocompatibility; Biomolecules; Chitosan; Crystallography; Energy harvesting; Microsystems; Microwave antennas; Nanotechnology; Piezoelectric devices; Piezoelectricity; Product design; Reflection; Substrates

Engineering uncontrolled terms

Chitosan film; Chitosan substrate; Design evaluation; Design simulations; Energy Harvester; Experimental evaluation; Natural biopolymers; Piezoelectric; Radio-frequency energy; Simulation evaluation

Engineering main heading

Monopole antennas

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Abstract

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