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A Fractal Metamaterial based Printed Dipoles on a Nickel Oxide Polymer Palm Fiber Substrate for Wi-Fi Applications

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Abstract: In this paper, a novel antenna circuit based metamaterial (MTM) structures is proposed for Wi-Fi applications. The antenna consists of two dipoles with 3×5 Hilbert - shaped MTM array printed with Sliver Nanoparticles Conductive Ink (SNPCI). The antenna substrate is mainly created from INP composite of: Iraqi Palm Tree Remnants (IPTR) and Nickel Oxide Nanoparticles (NONP) with Polyethylene (PE) mixture. The relative permittivity (ε_r) and permeability (μ_r) are measured using an open-stub microstrip resonator to find ε_r=3.106-j0.0314 and μ_r=1.548-j0.0907 at the frequency band of interest. Numerically, Finite Integral Technique (FIT) and Finite Element Method (FEM) of CSTMWS and HFSS formulations, respectively, are invoked to investigate the antenna performance. Experimentally, the antenna exhibits two resonances, $|S_{11}|$<-10dB, at 2.45GHz and 5.8GHz with gain of 2.6dBi and 4.8dBi, respectively. The antenna shows a bandwidth of 500 MHz around the first resonance and 2 GHz at the second resonance. The measured radiation patterns at the two resonances are found to be mainly directed toward the antenna end fire with radiation efficiency of 0.8 and 0.65 at the first and second modes, respectively. Finally, the proposed antenna performance is compared against a reference antenna to reveal the excellent enhancements.

Keywords: Fractal, metamaterial, polymer, dipole, open-stub.