06/2023

J Mater Sci: Mater Electron (2023) 34:1417

Synthesis and investigation of Sm^{3+}-doped $Mn_{0.5}Cu_{0.5}Fe_2O_4$ nanoferrites for microstrip patch antenna application

R. Rajesh Kanna[1,*], P. Jeyakumar[1], N. Lenin[2], G. Marimuthu[3], Mookkandi Palsamy Kesavan[4], and T. Venish Kumar[5]

[1] *Department of Electronics and Communication Engineering, M.Kumarasamy College of Engineering, Karur, Tamil Nadu 639 113, India*

[2] *Department of Physics, Sethu Institute of Technology, Virudhunagar, Tamil Nadu 626 115, India*

[3] *Department of Physics, Dhanalakshmi Srinivasan College of Engineering, Coimbatore, Tamil Nadu 641 105, India*

[4] *Department of Chemistry, Hajee Karutha Rowther Howdia College, Uthamapalayam, Tamil Nadu 625 526, India*

[5] *Department of Electronics and Communication Engineering, Nadar Saraswathi College of Engineering and Technology, Theni, Tamil Nadu 625 531, India*

Received: 8 March 2023
Accepted: 11 June 2023
Published online: 25 June 2023

ABSTRACT

Nanoferrites with chemical formulae of $CuFe_2O_4$ (CFO), $Mn_{0.5}Cu_{0.5}Fe_2O_4$ (MCFO), and $Mn_{0.5}Cu_{0.5}Sm_xFe_{2-x}O_4$ (SMCFO) were synthesized by the sono-chemical method as substrate material for microstrip patch antennas. The structural, oxidation, and vibrational characteristics of the nanoferrite substrate were analyzed through X-ray diffraction, X-ray photoelectron, and infrared spectroscopy. The lattice constant of the CFO nanoferrite is 8.413 Å, whereas that of MCFO is 8.429 Å, which is smaller than that of SMCFO nanoferrite. The spherical morphology of the nanoferrite substrate was observed through field-emission scanning electron microscopy images. The magnetic properties of the pristine and Sm^{3+}-doped $Mn_{0.5}Cu_{0.5}Fe_2O_4$ nanoferrites were studied using a vibrating sample magnetometer. The dielectric permittivity (ε_r) and dielectric loss tangent (tan δ_e) of the prepared nanoferrites were used as substrate to design the microstrip patch antenna by simulation using a high-frequency structure simulator. The R_L value of the simulated microstrip patch antennas was in the range of − 17.80 to − 46.28 dB at a frequency of 25 GHz. The voltage standing wave ratio values of the simulated microstrip patch antenna were between 0.08 and 2.41. Thus, it was concluded that the prepared materials can play an important role in developing flexible substrates for antennas in 5G mobile application.

Address correspondence to E-mail: rrajeshkanna63@gmail.com

https://doi.org/10.1007/s10854-023-10

NADAR SARASWATHI COLLEGE OF ENGINEERING & TECHNOLOGY THENI 625 531

Dr. C. MATHALAI SUNDARAM, M.E.,M.B.A.,Ph.D.,
Principal
Nadar Saraswathi College of Engineering and Technology
Vadapudupatti, Theni-625 531.