Solid State Phenomena
ISSN: 1662-9779, Vol. 307, pp 20-25
doi:10.4028/www.scientific.net/SSP.307.20

Submitted: 2018-11-22
Revised: 2019-07-03
Accepted: 2019-08-09
Online: 2020-07-17

A Study of Multiferroic $BiFeO_3$/Epoxy Resin Composite as Potential Coating Materials for Microwave Absorption

Siti Nor Ain Rusly[1,a*], Ismayadi Ismail[1,b], Khamirul Amin Matori[2,c], Zulkifly Abbas[2,d], Abdul Halim Shaari[2,e] and Idza Riati Ibrahim[1,f]

[1]Materials Synthesis and Characterization Laboratory, Institute of Advanced Technology, Universiti Putra Malaysia, 43400 UPM Serdang Selangor, Malaysia

[2]Department of Physics, Faculty of Science, Universiti Putra Malaysia, 43400 UPM Serdang, Selangor, Malaysia

[a*]sitinorainrusly@gmail.com, [b]ismayadi@upm.edu.my,[b]khamirul@upm.edu.my, [d]za@upm.edu.my, [e]ahalim@upm.edu.my, [f]idza411@gmail.com

Keywords: microwave; composites; multiferroic; $BiFeO_3$; absorbers

Abstract. A single layer of $BiFeO_3$ (BFO)/epoxy resin composite with thickness of 3 mm was fabricated by polymerized 70 wt% of sintered BFO as fillers and 30 wt% of epoxy resin polymer as matrix. The electromagnetic and the microwave absorption properties of BFO/epoxy resin composite were reported. The reflection loss (RL) of the same composite sample was measured by two different techniques of measurement, S_{11a} parameter (without metal backed reflector) and S_{11b} parameter (with metal backed reflector) in the range of 8–18 GHz using a network analyzer. Minimum RL (RL_{min}) from S_{11b} parameter for BFO/epoxy resin composite with metal backed is lower than the RL_{min} from S_{11a} composite without metal backed reflector. In details, the results showed BFO/epoxy resin composite with metal backed can achieve a strong absorption with RL_{min} of -40.5 dB over a 1.31 GHz bandwidth.

Introduction

The development study of microwave absorbing materials (MAM) have emerged owing to increasing requirements in commercialization and military field. MAM were mainly used to solve the signal disturbance created from electromagnetic (EM) interferences or used to suppress the reflection of EM wave from metal structure targets [1]. Hence, MAM have been extensively studied for their potential application in military and defense especially in stealth technology. MAM are coated on the structures so that it become less visible from radar detection by dissipating the microwave and transformed the absorbed energy into thermal energy. There are several factors causing the attenuation of microwave in MAM such as the permittivity (ε) and permeability (μ), intrinsic conductivity, matching thickness and aspect ratio of the fillers [2]. EM wave energy can be absorbed and attenuated into the MAM through magnetic and dielectric losses. The reflection loss (RL) usually presented the ability of the microwave absorption in the materials and more negative value of RL indicating that the absorbers have reflected the less EM wave signals. For normal incidence case, the RL of the material means the wave reflection from an infinite thickness of absorber which can be calculated directly from ε, μ and t (thickness) of the absorber as:

$$RL\,(dB) = 20\log\frac{(Z_{in} - 1)}{(Z_{in} + 1)} \qquad (1)$$