

Variation of Cole-Cole Model Parameters with the Complex Permittivity of Biological Tissues

Tarek M. Said^{1*}, and Vasundara V. Varadan²

¹Department of Electrical Engineering, Fayoum University, Fayoum 63514, Egypt

²Department of Electrical Engineering, University of Arkansas, Fayetteville, AR 72701, USA

ABSTRACT Cole-Cole relaxation models have been widely used by researchers to extrapolate the measured permittivity of biological tissues to higher frequencies. There is much variability of the measured permittivity from one sample to another for the same type of tissue requiring different Cole-Cole fitting parameters. However, no studies have been conducted on the dependence of the Cole-Cole fitting parameters on tissue constituents such as their geometry, concentration and distribution. In this communication, a single-pole Cole–Cole model is used to fit the frequency dependence of the dielectric permittivity of fatty tissues. Different geometries of water distribution in fat are studied. Multiple scattering full wave simulation is shown to be a useful approach to catalog and analyze different types of geometries. This study can serve as a useful tool to extract more detailed information about a biological tissue from its dielectric permittivity and explain the variation of the measured data.

KEYWORDS Biological tissues, complex permittivity, Cole-Cole relaxation model, multiple scattering theory, water

*Address all correspondence to: Tarek M. Said, Fayoum University, Faculty Group, Electrical Engineering Department, E-mail: tms02@fayoum.edu.eg