Dielectric and Magnetic Properties of PANI-CA Composites

Balaji Dontha* and Asimina Kiourti
ElectroScience Laboratory, Department of Electrical and Computer Engineering,
The Ohio State University, Columbus, OH, 43212, USA

Recent work has demonstrated the potential of monitoring acetone released from the skin towards continuous diagnostics of fat metabolism and weight loss, among others (Mojtabavi M. et al, A PANI–Cellulose acetate composite as a selective and sensitive chemomechanical actuator for acetone detection, Advanced Device Materials, 2:1, 1-7, 2016). The approach uses a novel Polyaniline – Cellulose Acetate (PANI-CA) composite as a selective and sensitive chemo-mechanical actuator. As the sensed acetone levels vary, the PANI-CA strips (4cm x 3cm in footprint and 20 μm in thickness) deform accordingly.

In an attempt to quantify this deformation, we focus on electromagnetic approaches that integrate conductive materials into the composite PANI-CA polymer. By forming maps of acetone concentration vs. deformation angle, we envision wearable and continuous metabolic rate monitors. To develop such electromagnetic sensing mechanisms, the dielectric and magnetic properties of the PANI-CA material need to be known. To date, such properties have not been characterized. In this work, we report the first measurements of the relative permittivity, dielectric loss tangent, relative permeability, and magnetic loss tangent of PANI-CA composites. Our approach uses the Keysight Impedance Analyzer (E4990A) equipped with a dielectric fixture (16453A) and a magnetic fixture (16454A) and covers the 0.1 to 1 GHz range, as determined by the corresponding fixtures.

Our measurement results set the groundwork for future development of personalized metabolic rate monitors based on PANI-CA composites, relevant to sports, healthcare, and beyond.