Characterization and Testing of Skin-Mimicking Gels for Implantable Antennas Operating at ISM Band (2.4 GHz-2.48 GHz)

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Implantable antennas have a wide range of applications in medicine. Designing antennas for implantable systems is quite challenging due to the antenna size, impedance matching, low power requirements, and biocompatibility with the body's own physiology. Because *in vivo* testing of the implantable antennas in humans are quite cumbersome and such measurements are subject to very tight regulations by the FDA, it is important to develop *in vitro* testing techniques to verify the proper functioning of these antennas. In a recent study, an implantable dual-band antenna operating at MICS/ISM bands was designed and fabricated for in body wireless data telemetry (*T. Karacolak, and E. Topsakal, North American Radio Science meeting, Ottawa, Canada, July 22-26, 2007)*. This antenna was tested using a skin-mimicking gel which aimed to match the electrical properties ε and σ of real human skin that was previously measured in the literature (*C.Gabriel, S.Gabriel and E.Corthout: "The dielectric properties of biological tissues: I. Literature survey", Phys. Med. Biol. 41 (1996), 2231-2249*). Although ε and σ of the skin-mimicking gel was successfully matched with real human skin for the MICS band, the skin-mimicking gels characterized for the ISM band had a higher conductivity. As a result, the minimum return loss obtained from measurements was around -9 dB.

The goal of this study is to characterize and test a proper skin-mimicking gel for the ISM band (2.4 GHz-2.48 GHz) for both wet (ε_r= 42.923, σ=1.5618) and dry (ε_r=38.063, σ=1.4407) human skin. To do so, we used DGBE (*Diethylene glycol butyl ether*), triton, agarose, and water mixtures. The electrical properties of the gel were measured using Aligent's dielectric probe kit. We observed a good agreement between the electrical properties of the gels and human skin at ISM band. We also performed *in vitro* test for a dual band (MICS/ISM) antenna while the human skin properties for the ISM band. *In vitro* measurements are performed using the E8362B PNA network analyzer. We observed a significant improvement in the antenna return loss for the ISM band.