Hybrid Hydrogels for Medical Applications of Microwaves

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The development of medical technologies that utilizes microwaves is in the rise. In general, a development cycle includes computer simulations, *in vitro* laboratory experiments, and *in vivo* animal/human studies. The testing stage is vital in guaranteeing the proper functioning of the new, developed equipment. Because *in vivo* testing of electromagnetic medical devices on humans is not practical during the initial design process, and such measurements are subject to strict regulations enforced by the Food and Drug Administration, there is a need for developing *in vitro* testing techniques that consist of synthetic materials that can mimic the dielectric properties of the tissue of interest. In the past, our group had developed and tested different tissue mimicking phantoms as an alternative to testing electromagnetic devices on human subjects. We have developed both homogeneous single-tissue gels such as skin, fat, muscle, and heterogeneous gels such as breast and brain. In particular, we have used these gels to test and validate implantable antennas for wireless telemetry applications. For such applications, we have obtained very good agreement when compared the *in vitro* gel results with the results from *in vivo* animal studies. However, there are certain medical applications that can physically affect the tissue of interest such as hyperthermia and/or ablation. For such applications, better representation of the tissue is required. Thus, in this study, we propose hybrid gels that are composed of both hydrogels and excised animal tissue. In order to show the feasibility of such approach, we develop several phantoms combining liver, heart and hydrogels. These hybrid gels can be used for both imaging applications (MRI) and during the initial stages of device development. In order to show the efficacy of the hybrid gels, we will provide measurement results.