Dual Band Biocompatible Titanium Nitrite Antennas for Implantable Wireless Telemetry

Ryan B. Green[(1)], Jon Dyke[(1)], Madeline Hays[(1)], Vitaliy Avrutin[(1)], Umit Ozgur[(1)], Martin Mangino[(2)], Erdem Topsakal[(1)]

(1) Department of Electrical and Computer Engineering, Virginia Commonwealth University, Richmond, Virginia, USA
(2) Department of Surgery, VCU School of Medicine, Virginia Commonwealth University, Richmond, Virginia, USA

Seven out of ten deaths per year in the United States are due to chronic diseases (e.g. cancer, heart disease, and diabetes). Approximately 23 million Americans had diabetes in 2015 while approximately 7.2 million in the same year went undiagnosed. The management of chronic diseases account for 86% of the $2.7 trillion health care costs in the US. The management and monitoring of chronic disease indicators, such as glucose, are uncomfortable for patients and offer data for both patients and doctors in limited time intervals. There is a demand for both patients and doctors to have continuous monitoring systems for chronic disease. Implantable sensors offer the capability to wirelessly transmit chronic health data from inside the human body to a monitor display system. The demand for this data and implantable sensors show the need for small and biocompatible antennas that can operate within the human body. Such designs will require slow degradation, high durability, and no toxicity when implanted. Titanium Nitride, a highly conductive, durable, and biocompatible nitride, is a promising material to fabricate biocompatible antennas to operate existing and emerging wireless medical telemetry infrastructures.

This paper presents the design, simulation, fabrication, and testing of a dual band implantable antenna using Titanium Nitrite as the radiating conductor. The implantable antennas designed operate at the WMTS Band (1.395 GHz – 1.432 GHz) and 2.4 GHz ISM Band (2.4 – 2.5 GHz). The antenna was designed to be implanted subcutaneously and was tested *in vitro* (via skin mimicking gel), *ex vivo* (via porcine tissue sample), and *in vivo* (via porcine animal models).