Implantable Titanium Nitrite Antenna for Continuous Glucose Monitoring

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In 2014, approximately 9% adults in the United States (8.5% globally) lived and managed diabetes. Those that are diagnosed manage their chronic illness with prescription medications and monitor their blood glucose levels with a glucose monitor. The most common method of glucose concentration monitoring is through blood glucose monitors that require the user to perform self blood draws. While providing accurate data, the monitor only offers a snapshot of glucose levels and not trends of glucose of minutes, hours, days, and months that would be beneficial to managing diets and medication regimens. As a result, there has been a demand by medical professionals to provide a continuous glucose monitor for their patients. While some continuous glucose monitors (CGMs) are on the market, they have technical bottle necks that limit their effectiveness. One such bottleneck is the sensor lifetime, which typically lasts between one and two weeks. This limitation can be remedied by using multiple sensor strategically exposed to interstitial fluid as a previously exposed sensor loses efficacy to extend the lifetime by weeks and months. Another bottleneck is the telemetry system miniaturization for subcutaneous implant. The major limitation in this miniaturization is the antenna design, using biocompatible sealants to isolate copper and other bio-incompatible materials from the human body. In comparison, these sealants have a low permittivity compared to the surrounding tissue. Using biocompatible materials such as Titanium Nitrite (TiN) to utilize the high permittivity of human tissues help facilitate miniaturization.

This paper presents a review of previous subcutaneously implantable antennas and implantable glucose sensors. This paper also presents the design and efficacy of an electrochemical glucose sensor for long term implantation. Additionally, this paper presents the design, simulation, and measurement data of a TiN antenna operating on the 2.4 GHz ISM band for subcutaneous implant.