Optically Transparent ISM Band Antenna for Wearable Medical Sensors

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The market for user health monitoring has expanded rapidly over the past decade. The emergence of the Fitbit, Garmin Vivofit, and even the Apple Watch allows the average consumer to not only monitor their pulse rate, blood oxygen levels, activity level, and calories burned, but now empowers the consumer to take charge of and enact a healthy lifestyle. Not only has this rise in wearable sensors caught interest in the consumer electronics market but has caught the interest in the medical community, which has long wanted the ability to remotely monitor real-time medical data ranging from heart health (Holter Monitor) to blood glucose levels (GlySens ICGM) and intraocular pressure. Intraocular pressure (IOP) sensors, in particular, have been designed and researched by means of a conductive ring sensor ring and antenna imbedded into contact lenses. Since these wireless sensors are becoming more and more pervasive in the wearable sensor industry, the need for optically transparent antennas rises as well. One such method used to fabricate optically transparent antennas is by means of a Transparent Conducting Oxide (TCO) such as Indium Tin Oxide (ITO) and Aluminum Zinc Oxide (AZO). Due to the rising economic costs of Indium and the toxicity of ITO and AZO, manufacturers and researchers are searching for new TCO materials to supplement and even replace these materials. One such replacement is Gallium-doped Zinc Oxide (GZO) due to its surface non-toxicity as well as similar conductivity to ITO.

This study investigates the use of optically transparent co-planar microstrip antennas for wearable medical sensors. This study designs and simulates antennas for the 2.4 GHz and 5.8 GHz Industrial Scientific and Medical (ISM) bands on a 375 um substrate (relative permittivity of 10) using GZO as a conductor (conductivity of 3.0×10^{5} S/m) . This study compares the return loss between the simulated and fabricated antennas. This study also presents the simulated gain and measured link-budget analysis of the designed antennas. This study shows that GZO can be used to produce antennas for wearable medical sensors.