Optically Transparent Antenna for 5G Communication

Ryan B Green[(1)], M.D. B. Ullah[(1)], Vitaliy Avrutin[(1)], Umit Ozgur[(1)], Hadis Morkoc[(1)], Erdem Topsakal[(1)]

(1) Department of Electrical and Computer Engineering, Virginia Commonwealth University, Richmond, Virginia, USA

As the demand for faster and more reliable connection to mobile broadband increases, so does the push toward the 5th generation (5G) communication protocol. Unlike the 3G and 4G systems, which focused on the mobile broadband user, 5G is predicted to pave the way for the Internet of Things and Machine to Machine communications. Such applications of 5G include the integration of smart cities, self-driving cars, and augmented reality entertainment in addition to broadband speeds exceeding Gigabytes per second. Logically, the push for the new protocol and scheme also pushes the development of new physical infrastructure to support. Many of these applications require the presence of additional antennas and even drives a necessity for aesthetically neutral radiators that can provide wireless communication. One such solution is the production of antennas utilizing Transparent Conducting Oxides (TCOs). TCOs, such as Indium Tin Oxide (ITO), have been used in the user electronics industry to produce LCD screens and touch screens that have helped drive the smartphone and tablet market. Due to the rising costs of Indium, Zinc Oxide films have been looked to a supplement and even replacement to ITO. Once such replacement is Gallium-doped Zinc Oxide (GZO) due to its similar conductivity to ITO. Due to its high conductivity, GZO is a promising candidate to manufacture optically transparent antennas for 5G communication.

In this study, several coplanar microstrip antennas operating at a carrier frequency of 28.5 GHz were simulated and fabricated on sapphire substrates (relative permittivity of 10) using Gallium-doped Zinc Oxide (conductivity of 3×10^5 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 Gallium-doped Zinc Oxide can be used to produce antennas for the next generation of wireless communication protocol.