

An Indium Tin Oxide Based 1-Bit Reconfigurable Intelligent Surface

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Reconfigurable intelligent surfaces (RIS) for mmWave 5G have been proposed in literature as a means of creating a smart, reconfigurable wireless environment, and to overcome high levels of signal loss due to free-space path loss at mmWave frequencies. These RIS devices enable the deliberate redirection of electromagnetic waves for increasing the signal strength in an environment via reflection. This redirection is done by tuning the individual phases of reflectors in a periodic array by either mechanical or electrical means. In the literature, prevailing research has focused on RIS designs made of substrate materials that are not transparent in the optical spectrum. However, this restricts RIS designs to only be applied to surfaces that do not require transparency, such as walls, and makes the design visible unless it is embedded in a structure. This impedes, if not prevents altogether, the ability to use RIS on structures that require transparency (i.e., windows). In this situation, if the RIS is not embedded into a structure, integrating RIS into walls or other structures of a building may not be desirable due to aesthetics. This work proposes a proof of concept optically transparent RIS for the 5 GHz WiFi band to demonstrate the ability of transparent materials to be used in RIS designs. The transparent RIS is made of soda lime glass sputtered with optically transparent indium tin oxide (ITO) to address the aforementioned issues of current RIS designs that are not transparent. The design is a 1-bit phase shifting RIS using diodes for reduction in costs and ease in programming the array. Additionally, the design makes use of high-impedance biasing lines for the diodes to avoid the need of multilayered design using vias, which is not feasible for a transparent design using glass or other brittle, transparent materials.