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Controllable millimetre-wave reflection metasurface with Schottky diodes

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5G and beyond communication systems introduce a new wireless environment which requires research towards new hardware technologies such as new antennas and metasurfaces. New beam steering techniques, low profile metasurfaces and control of electromagnetic emissions are some facets of this technological evolution. Both energy efficiency and energy-spectral efficiency point the need for designing metasurfaces that can control electromagnetic emissions.

An example of a design that controls emissivity is presented in [1]. The purpose of the metasurface is the enhancement of the reflected signal by controlling the reflection amplitude. A FET amplifier is located between two rectangular patches and provides the corresponding tuning range. Except for amplitude control, lumped elements have been applied to intelligent reflecting surfaces (IRS) to design unit cells that offer maximum phase range in terms of unit cell response [2]. The last fact allows real time control and high agility/flexibility over the radiation field. Even further Schottky diodes have been used to modulate Surface plasmon polaritons (SPPs) attenuation in higher frequency regime around 50GHz [3]. The diodes are fabricated by bridging the Spit-Ring Resonators' (SRRs) gap with IGZO oxide semiconductor. The SRRs lie on SPP waveguide.

In this contribution we present of a metasurface with the ability to dynamically controls the amplitude of the reflected signal. The unit cell comprises of two rectangular patches that are positioned on a Quartz substrate with a ground plane covering the rear side. C-shaped parasitic elements lie on the right and left side of the square patches. The leads of a Schottky diode are connected on each patch accordingly. The diode is reverse biased and different voltages insert shunt capacitance to the equivalent circuit modifying the total impedance. The tuning range for the amplitude values reaches 9.5dB while the operating frequency is 46.2GHz.

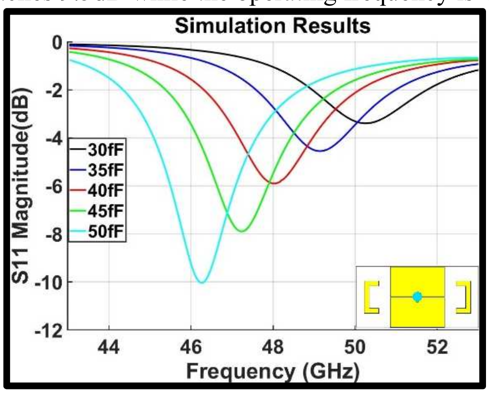

Figure 1. Simulations results of S11 magnitude for different Schottky diode capacitances. The proposed unit cell is shown as inset.

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2. A. Z. Ashoor and S. Gupta, "Towards Real-time Independent Control of Reflection Magnitude and Phase in Electromagnetic Metasurfaces," in *14th European Conference on Antennas and Propagation, EuCAP 2020*, 2020. doi: 10.23919/EuCAP48036.2020.9135493.
3.Y. Zhang *et al.*, "Tunable Surface Plasmon Polaritons with Monolithic Schottky Diodes," *ACS Appl Electron Mater*, vol. **1**, no. 10, 2019, doi: 10.1021/acsaelm.9b00499.