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Microwave based planar gas sensor using graphene and conducting polymer incorporated with double split ring resonator

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In this work, the microwave frequency range gas sensor is proposed. The design of the sensor is small electrical resonator i.e. Double Split Ring Resonator (DSRR) on 1mm thick FR4 Substrate. This small resonator is excited by transmission line i.e. high impedance line. This resonator has a resonant frequency of 13.73GHz and insertion loss of 8.22dB when simulated on Computer Simulation Technology-Microwave Studios (CST-MWS) and this resonant frequency changes to 13.85GHz and insertion loss of 7.60 dB when fabricated in fabrication laboratory. It works on the principle of change in the resonant frequency of DSRR when gas comes in contact with gas sensing material i.e. PEDOT: PSS with graphene. The variation in the frequency (i.e. with and without gas) is caused due to change in the conductivity of the conducting polymer i.e. PEDOT: PSS and Graphene when gas is allowed in the chamber. This shift in the resonant frequency is measured by measuring S-parameter i.e. S_{21} (insertion loss). PEDOT: PSS is a very effective candidate for gas sensing application in microwave range because of high conductivity and change in conductivity when comes in contact with gas.

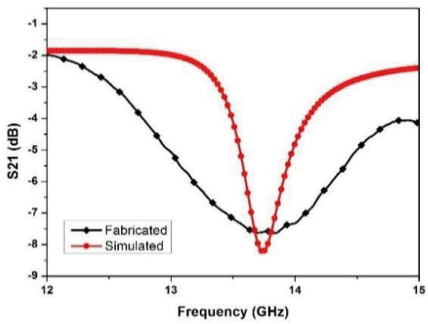

Figure 2: Insertion loss (S_{21}) v/s Frequency (GHz) comparison between simulated and fabricated DSRR

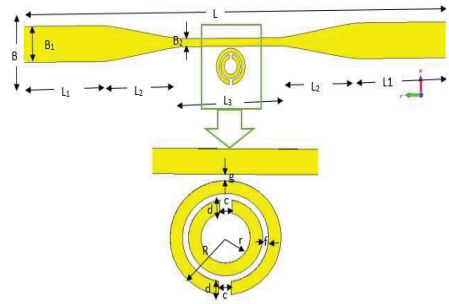

Figure 2: Electrically small resonator design

(a) High impedance transmission line i.e. B=15mm, B_1=1.78mm, B_2=0.4mm, L=30mm, L_1=7mm, L_3=6mm, L_2=5mm

(b) DSRR dimensions: g=c=d=0.2mm, f=0.1mm,, r=0.4mm, R=0.9mm.

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