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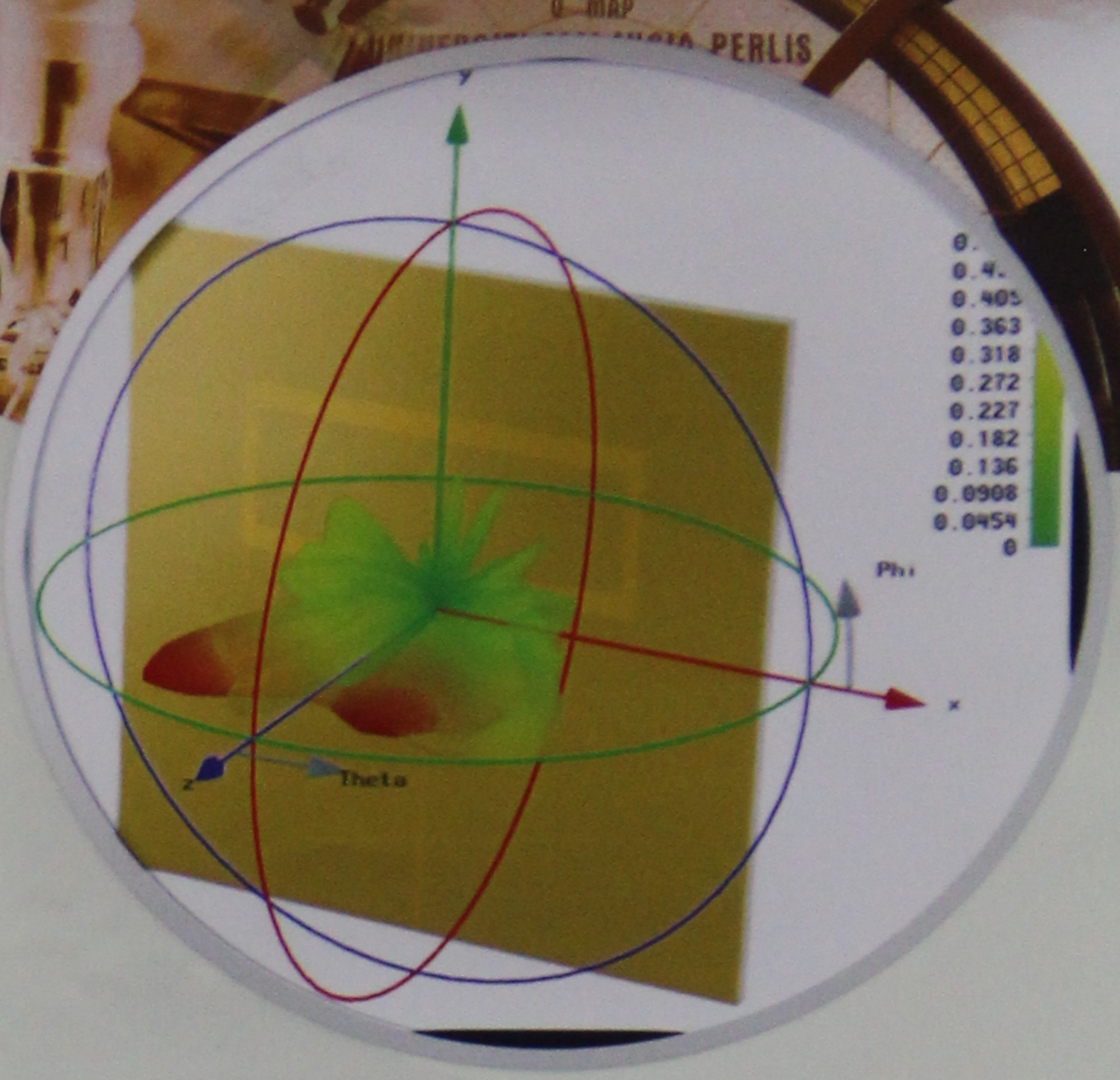
Graphene based nano-antenna



PRODUCT DESCRIPTION

The release of a license-free band around 60 GHz has triggered a international research effort on milimeter-wave (mm-wave) circuit and system design [1 - 3]. It is planned as an alternative for Wireless Local Area Network (WLAN) in very short range communication applications. Usage scenarios comprises, wireless link between a media player device, high definition television and high speed machine to machine comunication[4-5]. In such a scenario, very high date rates are necessary for a satisfying consumer experience. A new standard, IEEE 802.11ad, addressing wireless transmission in the 60 GHz band is in draft phase [6] and expected to be finalized.The constant scaling of graphene technology has resulted in graphene devices becoming the favored candidate for mm-wave operation and enabling the realization of low-cost 60 GHz transceivers [7 - 9].

PROBLEMS STATEMENT

Despite the rising number of circuits and solutions that were published over the past few years, some issues still hamper the optimal realization of a complete 60 GHz nano-antenna. **First**, inter-stage matching to 50 Ω, is common practice in microwave design. Limits the degrees of freedom and often results in additional power and area consumption when used for conventional 60 GHz design. **Secondly**, the tuning range of the conventional 60 GHz that are available in literature is insufficient to cover the available license-free band with some extra margin to account for if the tuning voltage is limited to the supply voltage [10]. **Thirdly**, gain selection must be implemented in a proper way, to prevent saturation of the RF circuitry

PRODUCT ADVANTAGES

Varying the graphene conductivity gives a high degree of freedom in controlling the output of the antenna escpecially is beamforming capability

NOVELTIES

The first antenna in the world with faster signalling capability

PUBLICATION

1. Ezanuddin, A.A.M, Ismail, A.H, "Tuning Graphene surface Resistance for a 52 GHz Nano-Antenna," **ICAMET**, International Conference on Advanced Material Engineering and Technology, Ho Chi Minh City, 2014.
2. Ezanuddin, A.A.M, Ismail, A.H, "Evaluating Graphene-based Nano-Antenna," **MIGS**, Malaysia-Indonesia Geopolymer Symposium, Kuala Lumpur, Malaysia, 2014.

PROCESS FLOW

The CPW ground electrodes width are optimized at 50 μm and length of 9350 μm. The graphene were initially simulated based on the followings, electrical permittivity is 3.3 and sheet resistance is 350 Ohms/sq [13].The real part of the intraband term of conductivity is dominating over and ultrawideband (UWB) range of frequencies starting from 45 GHz and ending at 65 GHz. In the same range of frequencies, the imaginary part is very small [14].

The intraband conductivity is given by:

$$\sigma(\omega) = \frac{-ie^2k_BT}{\pi\hbar^2}((\omega\text{-}i2\Gamma)[\left(\frac{\mu}{k_BT}\right) + 2ln(\exp\left(-\frac{\mu}{k_BT}\right) + 1)] \qquad (1)$$

where μ is chemical potential, $\mu \cong e\alpha V_b$. V_b as bias voltage and α – is a constant depending on the geometry of the device, T is the temperature and, Γ is a scattering rate independent of energy, Γ= τ /1, with τ = 1ps. The surface impedance is given by (1) :

$$Z_s(V_b) = \frac{1}{\sigma(\omega)} = R_s(V_b) + jX_s(V_b) \qquad (2)$$

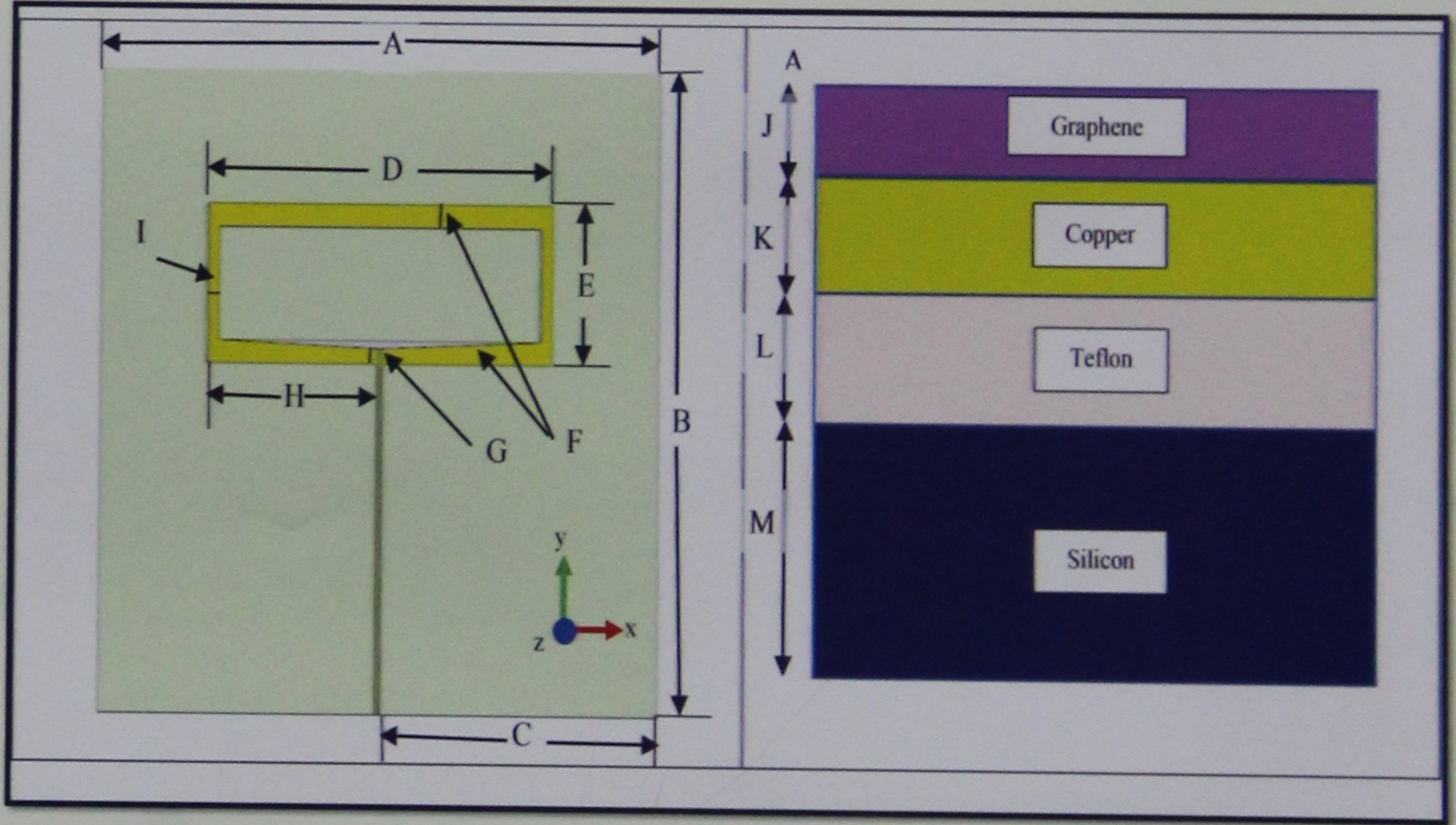


Figure 1 The configuration of graphene nano-antenna, A= B = 16500 μm, C = 16425 μm, D = 10200 μm, E = 4100 μm, F= 600 μm, G = 8950 μm, H = 4970 μm, I = 350 μm, J = 0.345 nm, K = 18 μm, L = 0.3μm, M = 500 μm.

PRODUCT PERFORMANCES

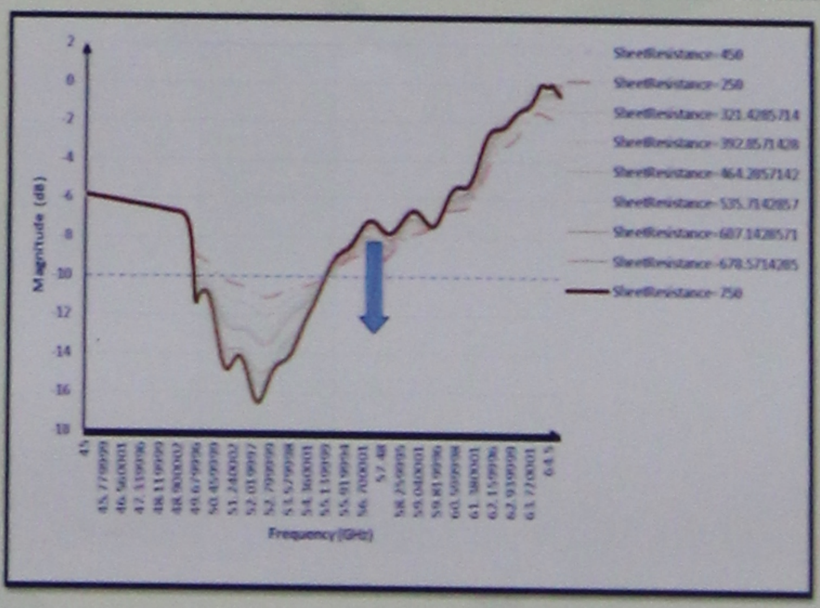


Figure 2 Insertion loss versus sheet resistance

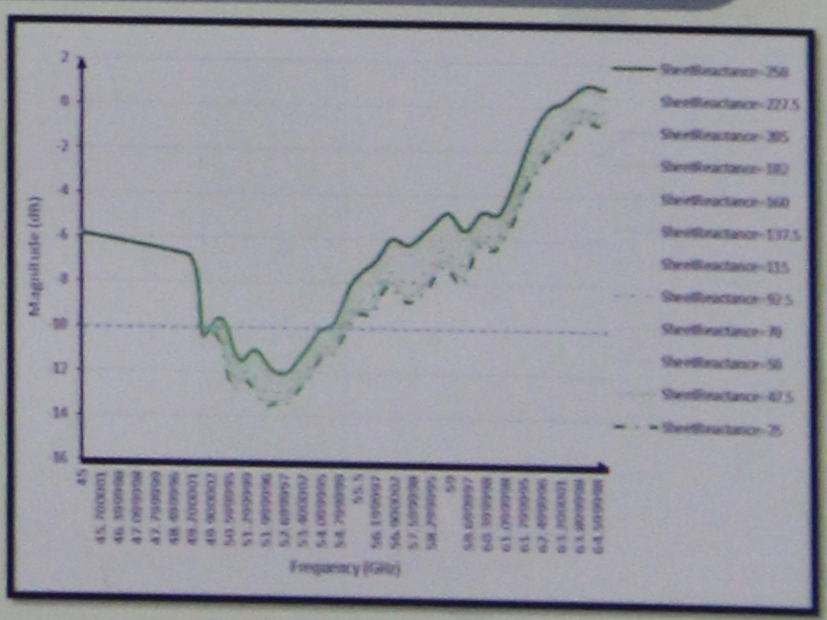


Figure 3 Insertion loss versus sheet reactance

POTENTIAL APPLICATION

Tuneable mmwave antenna