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Superconductor Substrate with Critical Temperature at 212 for Planar Antenna

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Abstract – This work presents a new planar superconducting rectangular microstrip antennas array, using the $Sn_5InBa4Ca2Cu_{10}O_y$ material, at use in critical temperature (Tc) of 212 K. In the analysis is used the concise full wave Transverse Transmission Line, (TTL) method. New results for the penetration depth as functions of the temperature, and resonant frequency as functions of the various antenna parameters, are presented.

Antenna arrays are made in planar microstrip configurations using common materials, in this work is used a very new superconducting material to patch $Sn_5InBa_4Ca_2Cu_{10}O_y$ [1].

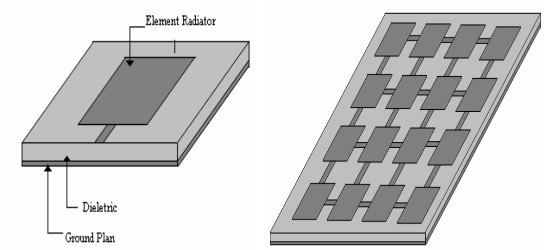
An microstrip antenna is considered in the preliminary study, consisting of an overlay irradiating elements of superconducting material, as shown in Fig.1 (a). The direction of the maximum gain of the array [2], is controlled by adjusting the phase of the signal in different elements of the array. The phase induced on the various elements is adjusted, so that the signal in a particular desired direction has maximum gain. The antenna used in this planar array, is shown in the Fig.1 (b).

The Transverse Transmission Line method [3], is used to determine the complex resonance frequency and irradiation diagrams. The characteristic theory of superconductor is developed using the of boundary condition resistive complex. Computational algorithms were developed in Matlab and Fortran Power Station languages.

Fig. 2(a) shows the resonance frequency [4] as function of the patch length, for different substrate thicknesses. The considerate parameters are w = 25 mm at 50 mm, *l* = 20 mm, ε_{r1} = 10.2, ε_{r2} = 1; and the (Sn5In) $Ba_4Ca_2Cu_{10}O_y$ [8] superconducting material at critical temperature of 212 K. Note that the increase in the thickness of the substrate, causes an decrease in the resonance frequency.

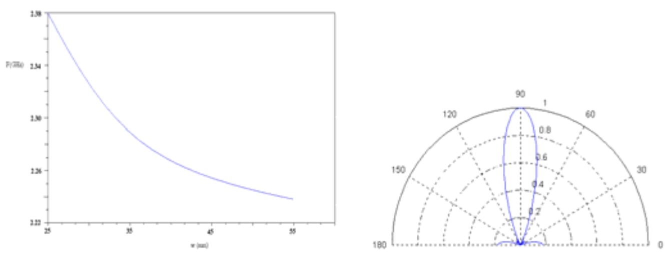
The E- plane pattern fields is shown in the Fig. 2 (b), with 25 (5x5) elements, with spaces $\lambda/2$, $\theta = 90^o$ and $\phi = 75^o$, resulting in $\beta x = -46,59^o$ and $\beta y = -173,86^o$;e $\theta = 90^o$, $\phi = 110^o$, $\beta x = 61,56^o$ and $\beta y = -169,14^o$ with superconductor substrate at Tc = 212 K.

The main theories used to explain the phenomenon of superconductivity has been used, at new superconducting materials $(Sn_5In)Ba_4Ca_2Cu_{10}O_y$. The resonance frequency depending on the parameters of the microstrip antenna and planar array configurations, and irradiation diagrams of the E- plane, were obtained. New numerical results were presented.



(a) (b)

Figure 1: a) Antenna to glide of superconducting microstrip. **b)** Planar superconducting microstrip antenna array of 4 x 4 elements.



(a) (b)

Figure 2: a) Resonance frequency depending on the width at temperature ambient 200 K for Sn5InBa4Ca2Cu10Oy.
b) Irradiation diagram in planar array in E-plane with superconductor substrate at Tc = 212 K.

References

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