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Design and analysis of Biodegradable Organic Substrate based Resonator

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ABSTRACT:

The paper presents design of biodegradable resonator working at ISM band frequency. The outer area of resonator is 57.26 x 66.36 mm^2 whereas the surface area of resonator is 48.36 x 39.5 mm^2. The paper is utilized as substrate and think copper sheets are utilized as resonator which are soluble in the water. The bandwidth of the resonator is 7.61% and peak gain of the resonator is 1.26dBi. The environment friendly and low cost resonator presents ability to be surface mountable on human body.

KEYWORDS: biodegradable resonator, surface mountable, soluble, environment friendly

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INTRODUCTION:

The need of surface mountableresonatoris increasing significantly due to demand of body-centric wireless communication[1]. Paper is quite compatible with the recent resonator printing environments such as inkjet, direct-write and copper lamination[2]. Due to compact size and light weight it offers direct application to surface mountable body-centric devices and wireless sensor motes. Several articles have been presented in design of resonator using paper substrate[3-10].

The paper an organic soluble substrate is widely available and it presents ease in integration with wearable devices being a low profile substrate. The mass production is also easy and cheaper. The paper dissipation factor is around 0.065 - 0.075 for frequencies ranging from 1 GHz to 2.6 GHz, the proposed resonator application frequency lies in this range. For the lower frequency resonator paper size becomes significantly high to achieve target application requirements hencethere are fewer resonators in sub-1GHz regime. Due to high dissipation factor the antenna gain shall be limited, however, it can effectively be used in short range communication for wireless sensor network motes. There are also other green energy based resonators proposed in the literature such as optically transparent antenna using PET and glass substrates[11-14]. This paper presents the paper substrate based resonator for WiFi communication systems.

DESIGN, RESULTS AND DISCUSSION:

The biodegradable organic substrate based resonator is illustrated in Figure 1. The height of the substrate was kept as 3 mm. This is based on standard 3 mm thick paper. Dielectric constant of used organic material is 2.34 and it has loss tangent of 0.065. The paper material is quite lossy which reduces overall radiation out of the resonator. The substrate width (Sw) was kept as 57.26 mm and substrate length (Sl) is kept at 66.36 mm. The resonator patch which is copper thin sheets has length Pl of 39.5 mm and width Pw of 48.36mm. The resonator patch was fed through microstripfeed line having width fl of 4mm.

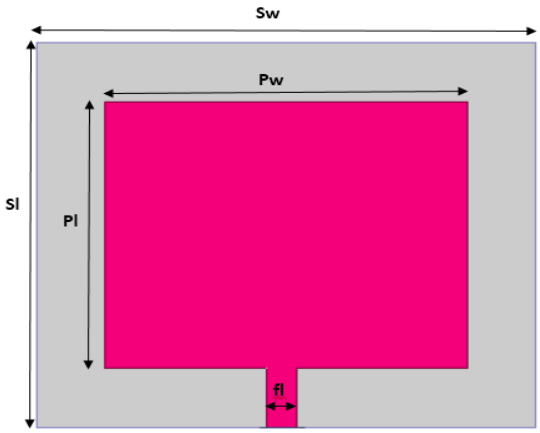


Figure 1: Proposed Resonator

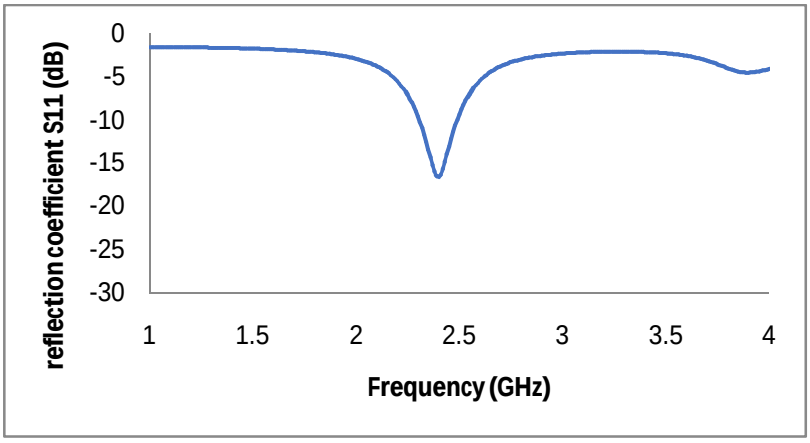


Figure 2: Reflection Coefficient of Resonator

Figure 2 illustrate the reflection coefficient of proposed resonator. As apparent from the figure resonator is resonating at ISM band of 2.5 GHz. The simulated bandwidth of the resonator is around 7.61% at target resonant frequency. The VSWR level of the proposed resonator is much better than 1.5 dB level which is required for Wireless communication devices. Figure 3 illustrates the surface current distribution of the proposed resonator. The device has maximum surface current at the feed line and near the radiating edges. The current distribution is least at the non-radiating edges. Figure 4 depicts the E-plane and H-plane radiation patterns of the antenna. Since the ground plane is completely covered with conducting copper sheet, the resonator has directive radiation properties. The peak simulated gain of the antenna is 1.26 dBi. The reduction in the antenna radiation and hence gain is due to high loss tangent of the paper which is utilized as a substrate.

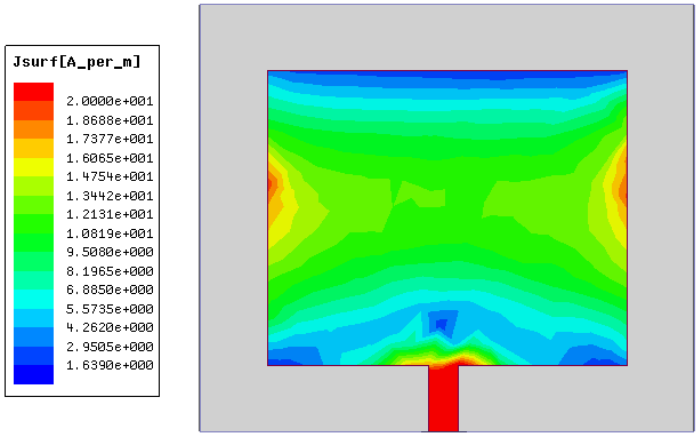
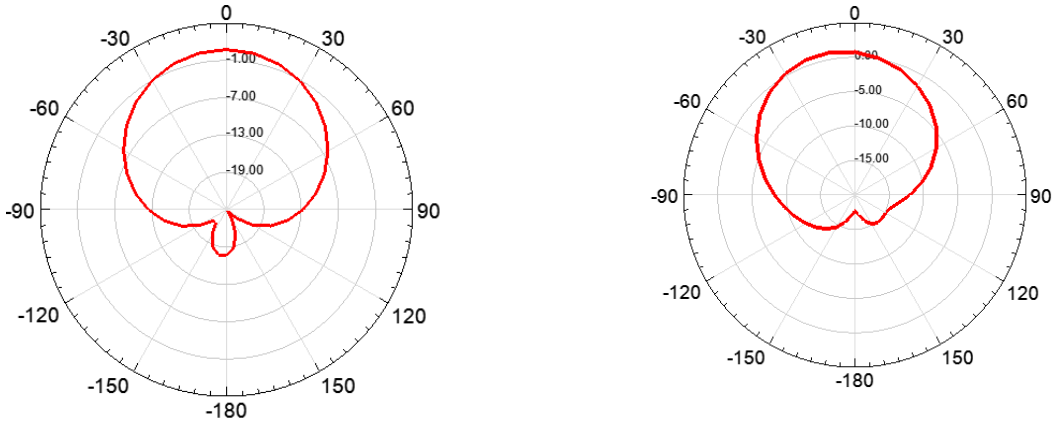


Figure 3: Surface Current Distribution of the resonator



(a) E Plane (b) H Plane

Figure 4: Radiation Patterns of the Proposed Antenna

CONCLUSION:

A Biodegradable paper based resonator was presented. The soluble resonator is extremely low-profile. The resonator is operating with wide bandwidth of 7.61% and has peak gain of 1.26 dBi. The low-profile resonator has capability to be surface mountable and presents potential application to ISM band communication devices.

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