HIGH FLEXIBLE AND DURABLE CARBON NANOTUBES ELECTRICALLY CONDUCTIVE POLYMER BASE ANTENNA FOR BLUETOOTH

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EXTENDED ABSTRACT

Key Words: carbon nanotubes,composite, antenna,wearableT-shirt

1. INTRODUCTION

The raising demands of wireless communication systems enforce the improvement of antenna that have abilities to operate under different standards in different frequency bands. The most of antennas can be made from a variety of materials. Obviously, a key requirement on the material is good electrical conductivity. Traditionally rigid materials were used for antennas, but recently flexible materials have attracted much attention, as these have several practical advantages. Currently so-called micro-strip antennas are used, built from metallic materials like copper foils, or copper and silver sheets; atop various substrates such as FR-4 or ceramic [1-5]. Different types of antenna, such as those using a meander stainless steel construction combined with plastic cover, may be found as well. Clearly, the choice of the conductive material has a decisive influence on the electrical antenna parameters. Currently used materials achieve very useful parameters in this respect, but antennas pre-fabricated from these materials are very complicated to embed into a polymer substrate [6-7].
The aim of the research presented in this paper is to explore novel material on the PU/CNTs based for manufacturing F shape antenna that better lend themselves for integration on a flexible carrier. Polymer base F shape antenna brings new possibility for standard metal antennas. Presented antenna is made by plastic technology which is very effective and fast. We also want integrated this antenna to the clothes or T-shirt. The goal of this project is transmit data from sensors which are integrate to the T-shirt to measure respiration activity of user.

In this contribution single band Planar Inverted F Antenna (PIFA) is presented (In the frequency range from 100 MHz to 4 GHz) . Main application is transmit collected data from smart wearable sensor incorporated in the smart clothes such as T-shirt. The main part (radiator) of antenna is made from PET foil coated by carbon nanotubes (CNT) polyurethane composite. This composite is electrically conductive but non-metallic material.

2. MATERIAL AND METHOD

Multi wall carbon nanotubes (MWCNT) The purified MWCNTs produced by the chemical vapor deposition of acetylene were supplied by Sun Nanotech Co. Ltd, China. According to the supplier, the nanotubes have diameters of 10–30 nm, length 1–10 μm, purity >90 % and electrical resistivity 0.12 Ω.cm.

Polyurethanes (PU) Desmopan® is a thermoplastic block copolymer characterized by a wide range of properties. Its linear polymeric chains consist of alternating flexible, elastic

segments. Polyurethane was used as a matrix and filler in this case is (CNT) The composite was made by ultrasonic mixing of both component. After that 30 % wt. composite was made in the form of dispersion. The deep coating was used for this layer preparation. We used PET foil as a substrate. After draying the desired shaper of antenna was made by cutting tols.

3. RESULTS

Prepared F – shape monopole antenna with dimension 10 x 31 mm and length of longer leg 10 mm and smaller 5.32 mm was analysed. We used spectral analyser to measure return loss parameters. Fig. 1 shows S_{11} parameters gain vs. frequency respectively. Resonant frequency of presented antenna is 2.4 GHz

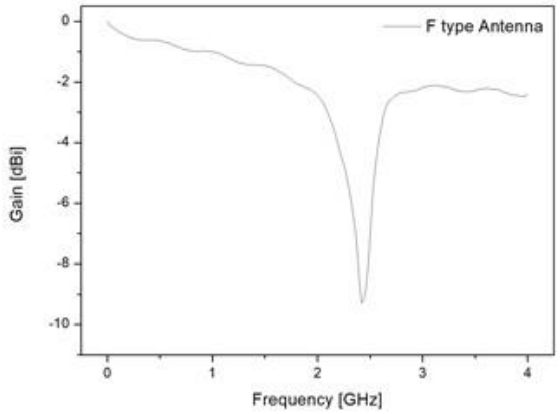

Fig.1 Frequency analysis of prepared PU/CNT flexible antenna.

All measurements of the printed antenna were performed in the anechoic chamber using the N9912A FieldFox Handheld RF spectrum analyzer with a measuring range within 2 MHz to 4 GHz. By means of this spectrum analyzer the parameter S11 was measured; this parameter determines the best frequencies of impedance matching for the antenna. The dimensions of the proposed layer of the antenna radiator are 10 × 31 mm (Fig. 1). The weight of antenna radiator is 0.108 g. The ground plane of the antenna is made of FR-4 copper substrate sized 20 × 40 mm. By combining these materials a very efficient design of the (F type) antenna was achieved. The impedance of the PU/CNTs (F type) antenna is matched for frequency 2.4 GHz, (–9.2 dBi).

The main PU/CNTs (F shape) part of the antenna is connected by means of electrically conductive silver paste with a coax cable with an impedance of 50 Ω. This coax cable has a gold-plated micro SMA connector. The joint in the layer of silver nanoparticles is connected by means of the electrically conductive silver paste. Primarily, the main task of the silver paste is to minimize signal loss during transmission between the coaxial line and the actual (F type) antenna.

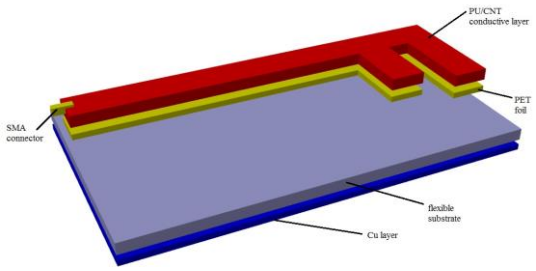

Fig.2 Visualization of prepared antenna

The radiator of F-shape antenna (Fig. 2) was prepared by cutting tools to get desired shape. The PU/CNT layer was prepared by deep coating technique on PET foil. F-type radiator was attached on flexible FR 4 substrate with thin Cu layer on the back side.

4. CONCLUSIONS

Presented F shape antenna was made from electrically conductive composite. The composite consist of CNT as a filler and PU as a matrix. The radiator of this antenna is fully non-metal and high flexible. Antenna also shows very good parameters such are gain and precise resonant frequency. The goal of this project was also fulfil we prepare very light, wearable, durable antenna for possible sport and military use.

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