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Design of simple printed Dipole antenna on flexible substrate for UHF band

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Abstract

In this article, we introduce an antenna printed on a flexible substrate. This prototype is intended for a flexible display device. The flexible screen has the advantage of being finer and more shock-resistant than the current slabs while allowing smart-phones to adapt to different uses due to its flexibility. The suggested antenna is a dipole with two symmetric frameworks printed on a Kapton polyimide substrate with a relative permittivity of 3.45 and a loss tangent of 0.002. The parametric study performed is based on the length and width of the proposed antenna; it shows that the proposed architecture is adapted to operate in the UHF band. The simulation and measurement results are in good similarity.

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Keywords: flexible electronics; Dipole antenna;Flexible substrate technology; Kapton polyimide; UHF band.

1. Introduction

In recent years there have been a large investment and research development around flexibility. Worldwide market turnover in flexible electronics exceeds 400 billion dollars. The flexible technology covers several applications such as a flexible display, printed RFID, flexible cellular solar energy and flexible lighting. At the

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global level, there are a very large number of research groups working on projects related to flexible electronics. Asian researchers mainly work on a flexible display but for American and European research groups, they work on the applications of flexible electronics in military and space systems [1]. The research work of these laboratories finds a clear path for the marketing of their products, especially due to their easy manufacture, price and light weight. These features make flexible paper, plastic and textile and hold a great candidate for a portable storage devices and portable flexible communication media as well. The integration of a communication system such as an antenna requires adapting their radiation characteristic to this flexible support without changing the radiation efficiency of these antennas. Some of the most popular flexible substrates found in the literature include Kapton polyimide film, Polydimethylsiloxane (PDMS) and polyethylene (PET). Antennas designed on flexible substrates such as papers, liquid crystal polymers (LCP) and PET films are reported in [2,3]. Two different multi-band antennas on a paper substrate are presented but without flexibility analysis [4,5]. A flexible antenna operates for near-field communication at the UHF frequency of 912 MHz [6]. In [7], a flexible single band antenna printed on a 46mm × 30mm paper-based substrate was proposed for integration into flexible displays for WLAN applications. Salonen et al. suggest a Dual-band E-shaped patch wearable textile antenna [8]. Masahiro et al propose White sides Stretchable Micro fluidic Radio frequency Antennas [9]. Also another work reported to [10] which studies and proposes a flexible bow-tie antennas based on synthesized flexible substrates. In the literature, we find other works that study the antennas for the UHF band and the printed antennas, which use rigid or flexible substrates [11,21].

This article suggests studying the design, simulation, and testing of a flexible antenna. For this purpose, we used, as a support for the radiating element of our structure, a polymeric Kapton substrate with a relative permittivity value of 3.5 and with a loss tangent of 0.002. This type of support is characterized by great flexibility and Low thickness of 0.0508 mm. This article will be structured as follows: a presentation of the kapton polyimide specification, the description of the simple geometry of the antenna, a parametric study on the radiation characteristics and comparison of measurement and simulation results.

Nomenclature

UHF	Ultra High Frequency
RFID	Radio-frequency identification
PDMS	Polydimethylsiloxane
PET	polyethylene
LCP	liquid crystal polymers
WLAN	wireless local area network

2. Kapton polyimide film specification and characteristics

The most commonly used flexible substrates are: electro-textile, paper based substrate and plastic substrate. In this part, we have specifically focused on the technical characteristics and specifications of the substrate used in the design of our antenna: the Kapton polyimide [22,23]. These polymers are classified into two categories and belong to the category of polymers resistant to high temperature such as Kapton film, first category, which is considered as the oldest. This type (PI- Polyimide) is obtained by sintering a powder under pressure and high temperature. The newest category, invented by NASA, is a polyimide thermoplastic transformed by injection or extrusion.

2.1. Properties of polymers:

First category of polymers: the first category is amorphous even if for the case of the film, some crystallinity occurs during stretching [23]. The fish coefficient is 0.41. The coefficient of expansion is from 20 to 260 ° C, from 30 to 50.10-6 depending on the material (ASTM D 696). After immersion at 23 ° C, the water absorption is 0.2%.

- Good dimensional stability and creep resistance
- Good resilience (43 J / m on notched specimen: ASTM D 256)
- A wear resistance, a conformability which ensures the sealing without deformation permed