

Accepted Manuscript

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PII: S0167-9317(17)30327-1
DOI: doi:[10.1016/j.mee.2017.08.007](https://doi.org/10.1016/j.mee.2017.08.007)
Reference: MEE 10629

To appear in:

Received date: 21 April 2017
Revised date: 19 August 2017
Accepted date: 27 August 2017

Please cite this article as: Kamel Guerchouche, Etienne Herth, Laurie E. Calvet, Nathalie Rolland, Christophe Loyez, Conductive Polymer based Antenna for Wireless Green Sensors Applications, (2017), doi:[10.1016/j.mee.2017.08.007](https://doi.org/10.1016/j.mee.2017.08.007)

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Conductive Polymer based Antenna for Wireless Green Sensors Applications

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Abstract

Despite the ubiquity of poly (3, 4-ethylenedioxythiophene):poly(styrenesulfonate) (PEDOT:PSS) as a high optical transparent conducting electrode in electronic devices, its potential as a low-cost fabrication conducting polymer film has not been fully explored. The motivation of this research is the development of a compact broadband antenna operating in the Radio-Frequency Identification at Ultra High Frequency band (RFID UHF: 860-960 MHz) for “Green”electronics and biosensor applications. In this paper, we apply a transparent conductive film on a recyclable and transparent glass substrate to achieve an original and aesthetic antenna for applications such as optical displays and window glass or sensors. We present and compare two designs made using the relatively low conductivity conducting polymer (CPs) PEDOT:PSS ($1.5 \cdot 10^4$ S/m) and a similar copper antenna ($5.8 \cdot 10^7$ S/m). The PEDOT:PSS antenna achieved a maximum gain of -8.6 dB, while the Cu antenna reached a gain of 2 dB. These results indicate that it is possible to obtain reasonable performance fully compliant with short range contactless technology and demonstrate the potential of conductive polymer materials for contactless technology devices, in particular for applications with recyclable sensors.

Keywords: RFID; “green”electronics; PEDOT:PSS; conductive polymers, biocompatible material; transparent.

1. Introduction

Since intrinsically conductive polymers (CPs) were discovered, 35 years ago they have found many applications. The rapid developments in conductive polymer science is a strong motivation for using these materials as alternatives [1, 2, 3, 4, 5, 6, 7, 8] to classic metallic conductors such copper and gold [9, 10, 11, 12, 13] as components in the design and fabrication of electromagnetic devices. Despite that the conductivity of polymers is lower than in metals, it has been shown to be sufficient to build antennas [14, 15, 16, 17, 18]. At the same time, emerging green materials are intended to achieve a more ambitious goal, defined by the integration of biocompatible, biodegradable and cost efficient electronics, such as, for instance, the monitoring or the diagnosis of humans with environmentally benign technologies. Among the most common conductive polymers shown in Table 1 [19, 20, 21, 22, 23], the most popular is PEDOT:PSS which was invented and patented in 1988 by Bayer AG [24]. PEDOT:PSS and its derivatives, which combine electronic, mechanical and optical properties, are scientifically interesting as well as technologically useful.

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