Design of Transparent Antenna Based on Inkjet-printed Graphene-PEDOT/PSS for RFID applications

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Abstract

Radio frequency identification (RFID) has been widely used in the field of industries. UHF RFID is widely used that the antenna structure is simply patterned by inkjet printing of conductive ink such as silver. However, this process requires solid materials to perform an antenna, which is not suitable for flexible and transparent applications. We developed a transparent graphene-PEDOT/PSS conductive ink by a simple one-step electrolytic exfoliation process instead of direct dispersion of graphene nanoflake into PEDOT/PSS in post-processing step. The transmittance was found as 80%. Moreover, the inkjet-printed graphene-PEDOT/PSS was modified on screen printed carbon electrode, which enhanced the conductivity for biochemical sensing [1]. Therefore, conductive polymers have been performed transparent RFID antenna. In this work, UHF antenna based on screen-printed graphene-PEDOT/PSS is designed and simulated for radio frequency identification (RFID) applications. The antenna structure was patterned by screen printing of graphene-PEDOT/PSS conductive ink. The electrical conductivity of graphene-PEDOT/PSS layer was measured to be 1,333 S/m by the four-point probe measurement. The graphene-PEDOT/PSS antenna was designed based on an RFID λ/2 structure to operate at a resonant frequency of 860 MHz. The designed antenna was 175 mm long, 80 mm wide and 300 nm thick as shown in Fig. 1. The polyethylene terephthalate (PET) was chosen as a substrate (thickness of 0.5 mm and dielectric constant of 3.8). The design was simulated with finite-element software, namely Advanced Design System over the frequency ranging from 500 MHz to 1.5 GHz. From the simulation results, the return loss of the graphene-PEDOT/PSS antenna was around -5 dB at the frequency of 864 MHz. The results show that the inkjet-printed graphene-PEDOT/PSS antenna can effectively be received and transmitted a radio frequency. The tag read range is 73 cm from RFID reader as shown in Fig. 2. Thus, the designed graphene-PEDOT/PSS antenna could be potentially be used for flexible and transparent RFID applications.

References

[1] Chakrit Sriprachuabwong, Chanpen Karuwan, Anurat Wisitsorrat, Ditsayut Phokharatkul, Tanom Lomas, Pornpimon Sritongkham and Adisorn Tuantranont, Journal of Material Chemistry, **Vol. 22** (2012) 5478-5485.

Figures

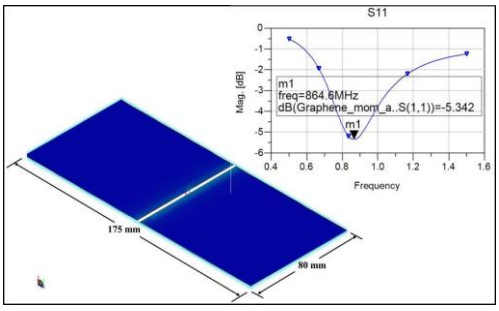

Figure 1. Structure and return loss simulation of graphene-PEDOT/PSS antenna.

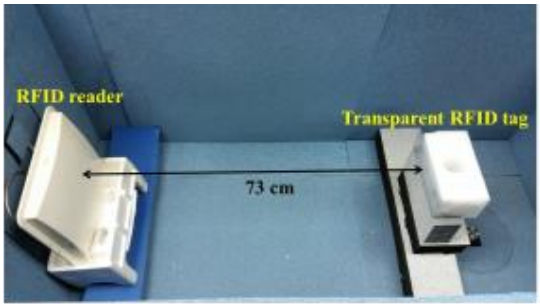

Figure 2. photograph of rfid test system