UNIVERSITI TEKNOLOGI MARA

A NEW FLEXIBLE ANTENNA FOR RFID APPLICATIONS

NUR ADYANI BINTI MOHD AFFENDI

Thesis submitted in fulfilment
of the requirements for the degree of
Doctor of Philosophy

Faculty of Electrical Engineering

November 2017

ABSTRACT

Flexible substrates have drawn considerable interest in providing new opportunities for future applications of telecommunication antennas. This thesis is dedicated to the development and application for an indoor/outdoor wearable antenna such as tagging or identification system for Radio Frequency Identification (RFID) using natural rubber (NR) composites. The thesis is divided into two parts. The first half focuses on the preparation of NR composites to achieve a material with optimal mechanical and electrical properties. The formulation consists of carbon black as the main filler, and other supporting ingredients as activators, anti-oxidants, softeners and accelerators. The preparation process of these samples consisted of mastication, mixing, curing and moulding. To quantify the flexibility of these samples, tensile tests were conducted according to the ASTM D638 standard using an *Instron* machine. The second half of the thesis concerns antenna development. Meander dipole antennas with a combination of capacitive tip-loading and T-matching were designed using *CST Microwave Studio*. The substrates employed in the design had permittivity of 3.3 and loss tangent 0.008. The overall dimensions of the antenna are $65 \times 65 \times 1.0$ mm^3. The UHF band was chosen with the operating frequency of the proposed antenna selected at 921 MHz. The fabrication of the prototype antennas involved copper foils cut into a meander shape, and then secured onto the rubber surface using a special adhesive. Coaxial feed technique was chosen to ease the fabrication process. Simulation and measurement of the antenna return loss and radiation pattern were conducted over the frequency range of 800 to 1000 MHz under two conditions: 1) flat and 2) bending along vertical and horizontal plane. The effect of the flat and the bending on the antenna's performance, mainly on the return loss and the radiation characteristics also been discussed. The antenna performances show good agreement between the simulated and the experimental results. The measurements were carried out using a *Rohde & Schwarz* vector network analyzer in an anechoic chamber. At the end of the study, prototype RFID tags were measured using an RFID reader to validate and demonstrate the worthiness of NR as a new flexible substrate for this application.

ACKNOWLEDGEMENTS

Initially, I wish to thank Allah for giving me the opportunity to embark my PhD and for completing this challenging journey successfully. I would like to express my sincere gratitude and appreciation to my supervisor, Prof. Dr. Zaiki Awang and my co-supervisor Dr. Tarmizi Ali. Thank you for giving ideas and assisting me with this research.

I want to state my appreciation to Prof Dr. Azemi and the staff of Faculty of Applied Science, UiTM for helping me with new knowledge. I am grateful for the help from the staff from Lembaga Getah Negara for providing the facilities and assistance. My colleagues, that always provided me with their generous help in research and companionship in these years.

Finally, I dedicated this thesis to my beloved husband, son and daughter, Izani, Ikhwan Adam and Qaseh Nur Inara, for their support and patience. The loving memory my late father, Haji Affendi, to my mother, Hajah Lamrah, for their vision to educate me and siblings, Hidhayah and Khairunnisa for motivated me. I cannot find any single word to express my deepest gratitude for your love, faith, patience and support. Alhamdulillah.

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