

Novel LIM (Laser Induced Metallization) Technologies of ITRI Applied to WWAN/LTE 2-Port Antenna Array for Smart Handset Applications

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Abstract – This article presents an internal multiband WWAN/LTE 2-port antenna array implemented by novel LIM (Laser Induced Metallization) technologies developed by ITRI in Taiwan. Through the proposed LIM technologies, the metal layouts of antennas and decoupling structures can be formed on surfaces of mobile phone casing successfully with a compact, conformal and highly integrating characteristic. Compared to the well-known LDS (Laser Direct Structuring) technologies, the proposed LIM technologies spray a special laser-activatable colloid on surface of supporter materials to replace prior metal-particle-mixed plastics of LDS for achieving more flexibility on substrate choosing in practical applications. The constructed prototype is discussed and analyzed in the paper.

Index Terms — WWAN/LTE, Multiband Antennas, MIMO Antennas, LIM (Laser Induced Metallization), Smart Phones.

I. INTRODUCTION

The increasing demand for the wireless communication quality has induced the development of multi-input multi-output (MIMO) systems, which can achieve a much higher channel capacity over that of the traditional wireless system with a single antenna [1, 2]. Hence, it would be desired to implement multiband WWAN/LTE MIMO or pattern diversity antennas into a single smart handset device. However, it is not an easy task for designing two adjacent antennas operating in the same frequency bands with good isolations, especially in the limited internal available space of smart phones. Some studies about WWAN/LTE MIMO antenna designs have been discussed in the open literatures [1, 2]. Nevertheless, most of the prior designs are mainly studied by the FR4 manufacturing process, more integration varieties could be achieved by different manufacturing technologies.

In order to achieve antenna designs with more compact and integrated sizes, the direct LDS (Laser Direct Structuring) technologies have become very famous and popular in the recent years [3, 4]. With LDS technologies, the antenna metal layouts could be implemented on the 3D surface of metal-particle-mixed mobile phone casings.

This paper presents a novel LIM (Laser Induced Metallization) technologies developed by ITRI of Taiwan [5]. Through the LIM technologies, the metal layouts of antennas can be formed on surfaces of mobile phone casing

successfully with conformal, highly integrating characteristics and more flexibility on substrate choosing [5]. Besides, some capacitive or inductive layouts can also be integrated with antenna designs. A constructed prototype of WWAN/LTE 2-port antenna array will be studied in this paper.

II. ANTENNA DESIGN

Fig.1 shows the manufacturing process of proposed LIM technologies. The LIM technology sprays a special laser-activatable colloid on surface of supporter materials to replace prior metal-particle-mixed plastics of LDS for achieving more flexibility on substrate choosing in practical applications. The laser-activatable colloid contains epoxy, PU, and 1~3% of nano-ceramic particles. After the colloid has been well-adhesion and solidified with the substrate. The laser energy is used to directly define the metal layouts. After that, the electro-less plating process is applied to form the metal patterns.

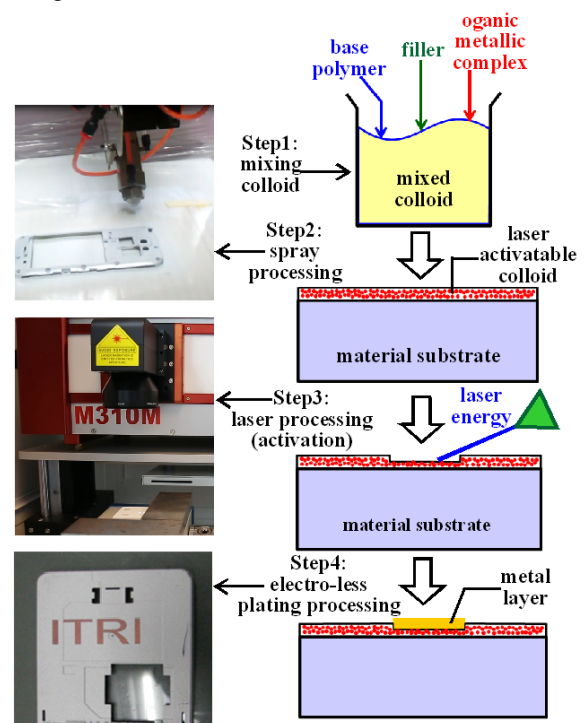


Fig. 1. The manufacturing process of proposed LIM technologies of ITRI.

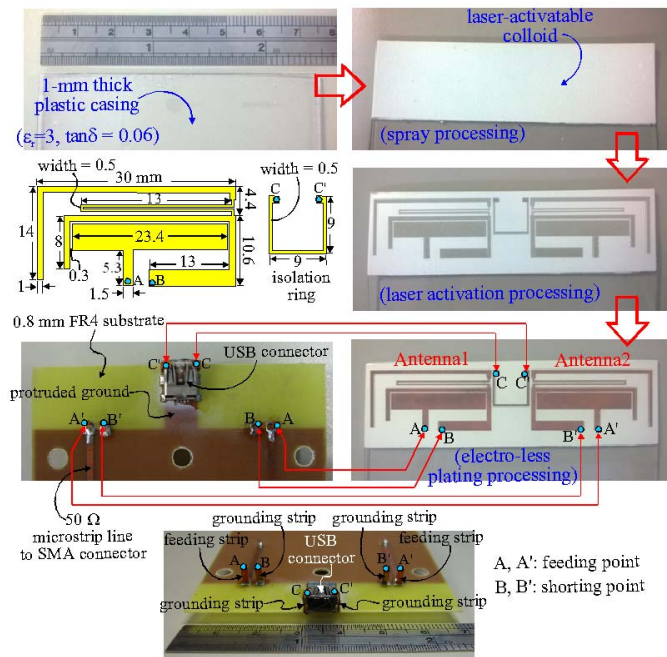


Fig. 2 Geometry and experiment photos of the proposed WWAN/LTE 2-port antenna array implemented by the LIM technologies of ITRI.

Fig.2 shows geometry and experiment photos of the constructed WWAN/LTE 2-port antenna array by LIM. It consists of two WWAN/LTE antennas [6] with a U-shape decoupling mechanism and a protruded ground embedded therebetween [1, 2]. Main layouts of the two antenna designs and the decoupling mechanism are directly formed on the inside surface of a plastic handset casing through the proposed LIM technologies successfully. For achieving wide operating bandwidth, the antenna design is formed by a coupled-fed loop resonant structure connected with an inductor-loaded strip [6]. In the prior studies [1], the inductor is achieved by a ceramic chip component which functions as a low-pass filter. However, through the proposed LIM technologies, the chip inductor can be replaced by a long meandering inductive strip successfully and integrated with the antenna layouts on the casing together as shown in Fig. 2. The two ends of the U-shape decoupling strip are shorted to the protruded ground accommodated with a USB connector through two grounding strips, which can greatly improve the isolation level between the two adjacent antennas.

III. RESULT AND DISCUSSION

Fig.3 (a) and (b) show the simulated and measured s-parameters for the proposed antenna array. From the results, good agreement between the measurement and simulation is seen. The reflection coefficients (S11 and S22) show that the obtained operating bandwidth (3:1 VSWR) of the two antenna ports (A and A') can cover the whole LTE700/GSM850/900 and GSM1800/1900/UMTS/LTE2300/2500 operations. The isolation between the 2-port antenna array can be achieved lower than -10 dB over the lower system bands, and lower than -15 dB over the higher system bands. For the lower system bands, radiation efficiencies vary from 45~60%. For the higher system bands, radiation efficiencies

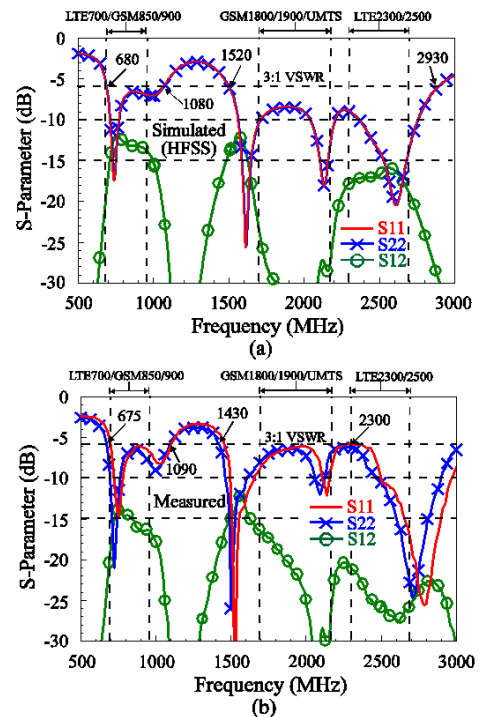


Fig. 3 (a) Simulated and (b) measured S-parameters of the proposed WWAN/LTE 2-port antenna array.

vary from 45~80%. The envelope correlation coefficient (ECC) [1, 2] between the 2-port antenna system all remain under 0.23 over the lower system bands, and under 0.02 over the higher system bands. Complementary radiation patterns can also be achieved for the proposed 2-port array. Details about the analysis of far-field antenna characteristics would be presented in the conference.

IV. CONCLUSION

An internal multiband WWAN/LTE 2-port antenna array implemented by proposed LIM technologies of ITRI has been presented. Through the LIM technologies, the metal layouts of antennas can be formed on surfaces of mobile phone casing successfully with conformal, highly integrating characteristics and more flexibility on substrate choosing. Some capacitive or inductive layouts can also be integrated with antenna designs directly.

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