A COMPACT QUARTER WAVELENGTH FILTER FOR 3D MICORWAE PRINTING OF CONTINUOUS FIBER REINFORCED POLYMERS

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3D microwave assisted printing of continuous fiber reinforced polymers can significantly increase the printing speed, volume and saves energy consumption compared with the state of the art printing technologies. Continuous fibers, especially carbon fibers provide high strength to weight ratio of the printed complex lightweight components. The microwave heating brings not only benefits, but also challenges. One of them is to limit the microwave energy in the cavity and avoid leakage. Here, a combination of equivalent circuit analyzing and finite element computing has been employed to design a novel quarter wavelength coaxial filter for a 3D microwave printing head. A compact size is needed to prevent collision with printed structures and a robust band-pass filtering ability is the key to adapt multi-diameter filaments. More importantly, an effective S-parameter testing method of the coaxial resonant filter is required. As shown in Fig.1 (a), a parallel RLC equivalent circuit has been used for analyzing the resonant filter performance. The influence of various circuit parameters (C1, C2, L1, R1) to the resonance behavior has been researched. Finally, a compact quarter wavelength resonant filter filled by dielectric material (e.g. PTFE) has been developed as shown in Fig. 1 (b). The filter with a length of 21.5 mm and 4 mm diameter has a broad-band filtering ability (|S21| > 20 dB) ranges from 2.41 to 2.46 GHz.

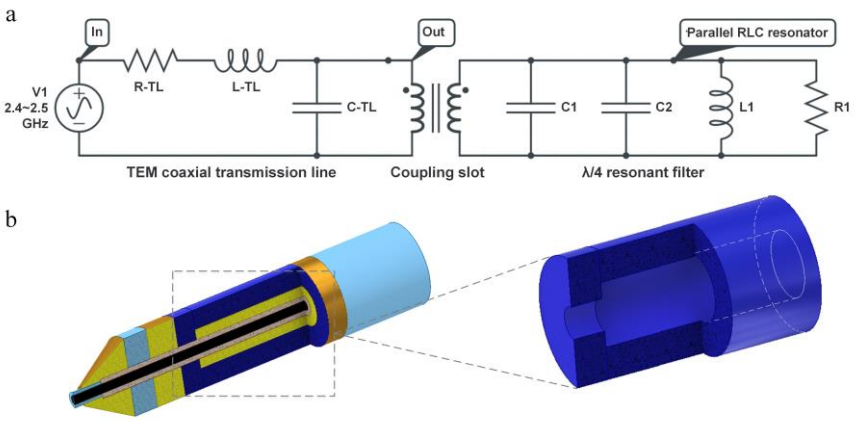

Fig. 1. (a) equivalent circuit of quarter wavelength resonant filter, (b) designed compact filter used for 3D microwave printing process.