Characterization and Modeling of K-Band Coplanar Waveguides Digitally Manufactured Using Pulsed Picosecond Laser Machining of Thick-Film Conductive Paste

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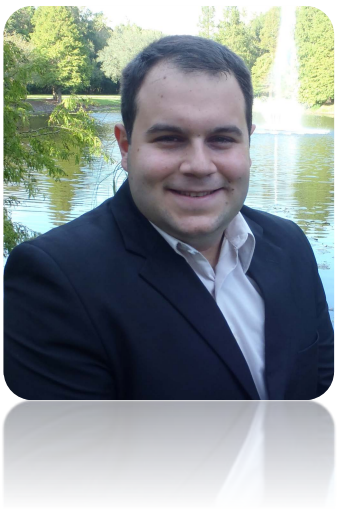
Abstract

Microdispensing of thick-film conductive paste has been demonstrated as a viable approach for manufacturing microwave planar transmission lines. However, the performance and upper frequency range of these lines is limited by the cross-sectional shape and electrical conductivity of the printed paste, as well as the achievable minimum feature size which is typically around 100 µm. In this paper, a picosecond Nd:YAG laser is used to machine slots in a 20-25-µm-thick layer of silver paste (Dupont CB028) that is microdispensed on a Rogers RT5870 substrate, producing coplanar waveguide (CPW) transmission lines with 16-20 µm-wide slots. It is shown that the laser solidifies an about 2-µm-wide region of the edges of the slots, thus significantly increasing the effective conductivity of the film and improving the attenuation constant of the lines. The extracted attenuation constant at 20 GHz for laser machined CB028 is 0.74 dB/cm. CPW resonators and filters show that the effective conductivity is in the range from 10 to 30 MS/m, which represents a 100x improvement when compared to the values obtained with the exclusive use of microdispensing. This paper demonstrates that a hybrid approach of additive manufacturing and laser machining enables the fabrication of higher frequency circuits (up to at least 40 GHz) with improved performance.

Bio



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He became a Ph.D. student and a member of the WAMI group at the University of South Florida in 2012. His doctoral research focused on additively manufactured Microwave Circuits and Antennas. Specifically, his work was oriented in developing new structures, materials, and techniques with the objective of creating 3D printed devices with improved performance. He has more than 20 peer-reviewed publications. He is also a reviewer of the journals *IEEE MTT-S Transactions on Microwave Theory and Techniques*, and *Proceedings of the IEEE*. He is an Assistant Professor in the Department of Electrical, Computer, Software and Systems Engineering at Embry-Riddle Aeronautical University, Daytona Beach, FL.