Curing Printed Conductive Layers on Low-Temperature Substrates with Intense Pulsed Light

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Abstract

Printed electronics is a branch of additive manufacturing that enables rapid prototyping and low-cost fabrication of devices for a wide range of applications, including antennas and other RF/microwave components. Although several materials and approaches are used in printed electronics manufacturing, the focus herein will be the application of intense pulsed light (IPL) to conductive inks printed on flexible substrates. IPL enables the rapid curing of printed conductive inks on the order of milliseconds over a large area and can be applied in roll-to-roll processing. This transient processing allows thin films to achieve high temperatures on a wide range of low-temperature substrates, such as thermoplastics, textiles, and paper. During this process, light is absorbed by the metallic ink, which causes a rapid temperature increase that removes insulating organic constituents or sinters the film into a single component. This process is affected by several factors, including the chemical and physical characteristics of the ink and substrate, the applied energy density, and the pulse parameters. Metallic ink composition can range from stabilized silver or copper nanoparticles to metal–organic complexes that decompose in the presence of heat and light. In addition to sintering, IPL can induce a chemical change in the ink, for example, the reduction of copper or silver. This presentation will focus on the application of IPL to silver and copper inks printed on flexible substrates and how the ink composition, substrate material, and IPL parameters effect the DC conductivity and RF performance of the conductive film.