Curing Copper and Other Thin-Film Materials at Production Speeds

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Introduction

To grow as a market technology segment, Printed Electronics products such as advanced displays, packaging, portable consumer electronics, and flexible solar cells must be able to be manufactured at commercial scale and cost, and in novel form factors. The PulseForge tools from NovaCentrix address these needs by providing the ability to dry, sinter, or anneal inks and thin-film materials in only milliseconds, and to be able to do so on a wide variety of substrates, including low temperature, flexible materials. PulseForge tools can reduce product material costs, reduce manufacturing cycle times, and enable new innovative form factors.

Comparative Conductive Ink Performance after PulseForge Processing

Comparative data from both silver and copper-based inks on low temperature substrates are presented. Sheet resistances as low as 15 mΩ/□ and resistivities as low as 2.5X bulk have been attained with silver. Sheet resistances as low as 70 mΩ/□ have been attained with copper. Substrates evaluated are challenge materials of cellulose paper and PET. Typical ink thickness processed is 0.5-25 microns. PulseForge tools are able to process copper inks, overcoming the oxidation reaction which has historically hampered the wider adoption of copper as a low-cost alternative to silver ink materials.

Technology Basis

The key element of the tools is the patented pulsed light technology which uses proprietary lamps to deliver the energy required to effect the desired material changes. PulseForge tools are effective with materials deposited by methods such as inkjet, flexographic, gravure, screen print, chemical vapor deposition, aerosol, and spin-coat processes.

Replacing Alternative Processing Techniques

Where ovens can require minutes or hours of processing time, the PulseForge tools require less than a second. PulseForge tools can also process substrate materials incompatible with thermal ovens. For example, PulseForge tools can sinter silver conductive inks on materials such as PET, PVC, and even paper. The process is also able to cure materials that cannot ordinarily be thermally processed in air such as copper particle inks. Unlike laser curing, the process is broadcast by nature and maskless. Furthermore, the millisecond timeframe of the process makes it ideal for high speed printing applications for materials even beyond metal inks.

Summary

By using short-duration pulsed light, PulseForge tools improve the conductive performance of inks and thin-films on low-temperature substrates as needed for Printed Electronics. Inks can be dried or sintered on substrates with low melting temperatures, such as thin plastics like PET, PVC, polyethylene, and other materials such as paper. These tools are commercially available in models for application development, and for production with roll-to-roll or conveyor speeds of hundreds of feet per minute.