Ph.D. in Information Technology
Thesis Defenses

September 7th, 2023
at 11:00
Room "Aula Seminari Alessandra Alario"

Giuseppe Barbalace– XXXV Cycle
Innovative D.O.D. printing for micrometric inductors
Supervisor: Prof. **Dario Andrea Nicola Natali**

Abstract:

In the framework of electronics component manufacturing, additive technologies (more popularly known as 3D printing techniques) are gaining a growing importance year by year.
These techniques, thanks to their properties of implementation easiness, fabrication speed, amount of required material and limited energy consumption, are of great interest when compared to standard subtractive technologies.
Printed electronic devices performances noticeably improved in recent years and, unlike standard "rigid" electronics, they are characterized by compatibility with flexible applications and roll-to-roll processes. Among passive components manufacturing through additive techniques, the production of high quality micrometric integrated inductors can be of great interest in different contexts.
Standard inductors could be created through electrochemical processes, but they imply a lot of wastes and high costs to reach conductor thickness of relevance to obtain high quality.
Shifting to inkjet printing is of great interest for such purpose, because conductor thickness can be increased by simply depositing more layers.
However, such technique requires conductive ink with high conductivity, micrometric and stable accuracy in deposition and low temperature treatments.
In this dissertation, an innovative printing methodology is proposed to obtain high quality factor micrometric silver inductors, according to specifications compliant with Galvanic Isolators applications in Very High Frequency range.
Conductive ink was deposited onto polyimide substrates with piezoelectric Drop-On-Demand (D.O.D) inkjet printing. The employed tool, a "All-in-one State-of-the-Art" device, enabled to both customize deposition trajectories and to keep a micrometric deposition accuracy in hours of activity, required to print up to 30 layers.
Printings became conductive after an annealing treatment, at temperatures noticeably lower than the standard electronic processes ones (below 250 °C).
Finally, a process to connect pads on a top metal layer with printed inductors on a bottom metal layer was successfully implemented, by allowing VHF-measurements to be performed.
Optimization of these process can be of interest for microelectronics manufacturing and for the integration of printed components with standard circuits.

PhD Committee
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