Laser selective sintering and patterning of laser printed silver inks for flexible electronics

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Laser micro-processing is a digital technology offering high degree of accuracy and selectivity, which can be exploited in processes such as printing, sintering and patterning of micrometric-sized wide conductive tracks for applications in flexible electronics [1]. Being able to selectively sinter printed tracks enables using cost-effective flexible substrates, which would otherwise degrade if employing other traditional non-selective sintering techniques, e.g. oven sintering. Further, laser patterning can be used to selectively remove material from the sintered tracks to facilitate making vertical interconnections at desired locations, while avoiding damage to underlying functional layers. All this is possible owning to the highly confined exposure of the materials to the laser radiation. Particularly when using short pulsed lasers in the range of nano to femtoseconds, the undesired heat affected zones can be limited to just a few micrometres or less [2]. Highly integrated modern laser sources with advanced computer numerical control and fast optical scanning systems allow for an accuracy in positioning and steering a laser beam in the range of just a few micrometres across large areas, which can typically reach several hundreds of millimetres.

In this work, these laser-based techniques are combined to achieve sintered and patterned conductive tracks for applications in flexible biosensors and RFIDs antennas. Two-probes conductivity measurements are performed after the laser processes to ensure the resistance of the tracks falls within specifications. Confocal microscopy is in addition employed to measure the diameters of the patterned blind holes that allow vertical interconnections, and to examine possible damage to the underlying functional layers after the processes. The resulting conductive and patterned tracks show a resistance better than 10x bulk silver, while the patterned blind holes have a mean diameter of 33.6±0.6 µm, after selectively removing an approximate printed line thickness of about 1 µm, without causing damage to the base functional substrate.

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