Nanocomposites and nanomaterials

Comparison of Different Sintering Methods of Inkjet-Printed Conductive Structures

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Inkjet printing of electronics components and sensors have been actively developing during the last fifteen years. Inkjet printing potentially enables fast roll-to-roll patterning of conductive material e.g. nanomaterials, including metal nanoparticles (generally Ag, Au, Cu, Ni or Co). Nanoparticles are covered with an organic layer to realize the dispersion, a solvent in which the particles are dispersed and additives to control the rheological behavior of the ink. After printing and evaporation of the solvents only the particles with the covering layer and the additives remains in the printed structures. The organic compounds have to be removed in order to uncover the particles and contact and/or sintering between the conductive particles is possible. The removal of the organic materials can be achieved by heating up the printed structures. Higher temperature during the sintering usually results in lower the resistance. When the structures are printed on polymeric substrates the temperature is limited due to the thermal stability of the substrate material. Two different alternative methods of sintering of printed structures have been used in order to reduce the thermal loading of the substrate.

The methods of sintering are the established thermal sintering in an oven, and alternatively laser sintering as well as electrical resistive sintering. Laser sintering is carried out with a semiconductor laser with a wavelength of 408 nm and different feeding speeds so the energy input in the structures can be varied. For electrical resistive sintering a DC-current is injected to the structures whereby they are heated up by the current. The best parameters for both sintering alternatives are identified. The conductivity and the deviation of the conductivity of the sintered paths are determined and compared with the results achieved for thermal sintering. As a result, it can be stated, that both alternatives provide specific advantages over thermal sintering such as lower deviations of the measured values or significantly lower process times. On the other hand, specific limitations might occur when using laser or electrical sintering.