Nanostructured inks based on gold nanoparticles and polyelectrolytes

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Evaporating colloidal suspension leads to the formation of a variety of solid patterns, ranging from the concentric rings of a dried coffee drop to the uniform deposits of solid pigments left after paint drying. In the last decade, several groups have shown that evaporating suspensions of plasmonic nanoparticles is an efficient way toward the elaboration of nanostructured functional devices such as for instance gauge sensors,1 substrate for Surface-Enhanced Raman Spectroscopy (SERS)2 or diagnostic tools3. In spite of these achievements, the final deposited nanostructures are rather big (µm) compared to the size of the nanoparticles, restricted to a limited number of 2D patterns, and the interparticle distance is poorly controlled, hindering the development of applications.

To increase the structural control at the nanometric scale, we developed a new method to self-assemble gold nanoparticles in bulk (3D) before deposition on model surfaces with controlled roughness and charge density. The nanostructuration relies on electrostatic interaction between negatively charged surfactants stabilizing the gold particles and ammonium functions of a polylysine-polyethylene glycol copolymer designed on purpose.

This presentation will first present the different structures (SAXS and cryo-TEM) obtained in bulk by complexation between nanoparticles and polymers (polyelectrolytes or grafted polymers). Then, the correlation will be established between these 3D structures and the 2D patterns obtained after droplet deposition and drying as a function of the surface characteristics (sign of surface charge and charge density) and the speed of droplet deposition (µ-pipette or inkjet printer). These results will be compared to those obtained with reference individual nanoparticles.

Figure 1. Deposition of nanostructured inks using the inkjet printing technique

References

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