Synthesis of nanostructures by discharges in liquid nitrogen

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The synthesis of cadmium-silver nanoalloy is achieved by nanosecond-pulsed discharges in liquid nitrogen between one cadmium electrode and one silver electrode.

Creating alloy nanoparticles with controlled composition is a major stake for it provides unprecedented opportunities to create materials with new properties. Creating nanosecond-pulsed discharges between two electrodes immerged in a dielectric liquid is a competing process to produce nanoparticles at high rate. It could be less expansive and cheaper that laser ablation. However, the way alloy nanoparticles are created in non-equilibrium discharges submitted to huge gradients in time and space is still unclear, especially in the case where electrodes are made of different metals. The possibility to assemble two metals into a single-phase alloy is limited to specific couples of metals (Pt-Pd or Ag-Pt for sufficiently long discharge pulses). Everything happens as if vapors did not mix. On the other hand, when the two electrodes are made from the same alloy, the composition of large enough (i.e. > 20 nm typically) nanoparticles is close the electrode composition. After a short description of the experimental set-up, results obtained by time-resolved optical emission spectroscopy will be presented first to follow the way radiative transitions of both elements, cadmium and silver, evolve as a function of the pulse width. In a second time, material results will be presented. Then, we will discuss mechanisms driving the synthesis of nanoparticles grown in the present conditions

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