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Synthesis of 2-Dimensional Lead Oxide by Discharges in Liquid Nitrogen

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Discharges in liquids are very efficient to synthesize nanoparticles at high rate. They can be used as well to assemble these nanoparticles into wires. However, till now, no other form of nanostructures was ever produced by this process.
By creating nanosecond-pulsed discharges in liquid nitrogen between two lead electrodes, we could produce for the first time 2-dimensional lead oxide hexagons. These hexagons are first produced as sheets of metallic lead during spark processing and oxidized next, once liquid nitrogen is evaporated, which enables oxidation by air. The sheets are collected onto wafers of different materials (silicon, copper, aluminum and steel) and analyzed next. AFM measurements show that hexagons are made of a stack of about 10-20 monolayers.
The growth mechanism of these specific nano-objects could be partly clarified. It is associated with the erosion mechanism of the electrodes. Facetted crystals of lead are produced when spark discharges hit the electrode. After about 1000 discharges, long facetted lead wires are observed still attached to the electrode. If more discharges are run, wires detach from the electrode and fall onto the wafer, which stops the production the sheets.
Thorough TEM analyses, coupled with XRD measurements, were necessary to identify the synthesized lead oxide sheets. Indeed, we found out that a new phase of PbO_2 was formed. Investigations are in progress to determine if this new material possesses original superconducting properties, as it might be expected from lead oxide.

Keywords
Dicharges in liquids
Lead oxide
2D nanomaterials