

PO4041

Synthesis of PbO₂ nanosheets by discharges in liquid nitrogenThierry BELMONTE¹, Ahmad HAMDAN¹, Hiba KABBARA¹, Alexandre NOMINE¹,
Cédric NOEL², Jaafar GHANBAJA¹, Abdelkrim REDJAIMIA²¹Institut Jean Lamour, NANCY, France ²Institut Jean Lamour, Nancy, France

thierry.belmonte@univ-lorraine.fr

A simple method to synthesize hexagonal sheets of lead, which belong to the class of two-dimensional materials, is presented. These objects can be collected on a substrate located under two lead electrodes between which nanosecond-pulsed spark discharges in liquid nitrogen are ignited. The hexagonal sheets are single crystals produced by gas phase condensation. Once nitrogen is fully evaporated, they are oxidized in the air and turned into a new phase of PbO₂. The oxidation process induces stress that may pleat the uppermost sheets or open cracks in the centre of the structure. The thickness of individual objects varies typically from 4 to 20 nm. If the number of discharges exceeds about 2000, two types of PbO₂ sticks start being observed: bundles made of nanosticks (5 μm in length and 50 nm of diameter) and isolated stick (20 μm in length and 500 nm in diameter) in addition to sheets. These new nanostructures are mainly due to the way lead electrodes are eroded by the discharge. At the beginning, the anisotropic erosion driven by the orientation of crystallographic planes of lead crystals produces octahedra and nanosticks, these latter growing longer and longer on electrode surfaces as discharges proceed. After about 2000 discharges, nanosticks are long enough to be easily broken, likely by mechanical stress, and fall onto the underlying substrate.

KeywordsLiquid nitrogen
spark discharge
PbO₂
nanosheet
2D materials