

# Lead Iodide Hydroxide Nanostructures: Sonochemical Synthesis and Characterization

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Ultrasound has become an important tool in synthesis chemistry to generate novel nano-sized materials under ambient conditions in recent years [1–3]. The ultrasound effects arise from acoustic cavitation, which is the formation, growth, and implosive collapse of bubbles in a liquid. The growth of the bubble occurs through the diffusion of solute vapor into the volume of the bubble, while the collapse of the bubble occurs when the bubble size reaches its maximum value. When solution is exposed to ultrasound irradiation, the bubbles are implosively collapsed by acoustic fields in the solution. According to hot spot theory, very high temperatures ( $>5000$  K) are obtained upon the collapse of a bubble. Since this collapse occurs in less than a nanosecond, very high cooling rates ( $>10^{10}$  K/s) are also obtained [5]. These extreme conditions can drive a variety of chemical reactions to fabricate nano-sized materials. Here, Pb(OH)I micro/nanostructures were prepared in the presence of ultrasound irradiation. On the other hand, *N,N*-bis(salicylidene)-ethylenediamine (H<sub>2</sub>salen) as a Schiff base compound was synthesized, characterized and applied as surfactant. Besides the H<sub>2</sub>salen molecules, the effect of sodium dodecyl sulfate (SDS) and polyvinylpyrrolidone (PVP) as surfactant on the morphology of the products was investigated.

For the first time, micro-/nano-sized lead iodide hydroxide; Pb(OH)I, has been successfully prepared via a simple ultrasonic method. In this method, lead nitrate and lithium iodide were applied as starting reagents to fabricate Pb(OH)I micro/nanostructures at different conditions. The effect of different surfactants like *N,N*-bis(salicylidene)-ethylenediamine (H<sub>2</sub>salen), sodium dodecyl sulfate (SDS) and polyvinylpyrrolidone (PVP), sonication time, and ultrasonic intensity on the morphology and particle size of the products has been investigated. The as-produced micro/nanostructures were characterized with the aid of XRD, SEM, TEM, UV-vis, EDS and FT-IR. According to the SEM images, different morphologies of Pb(OH)I including micro- and nano-sized rods were formed by changing the preparation conditions. Based on the XRD results, it was found that Pb(OH)I and PbI<sub>2</sub> have been produced with and without sonication at the same conditions, respectively. The use of the H<sub>2</sub>salen and sonication treatment were confirmed to be the crucial factors determining the formation of one-dimensional Pb(OH)I micro/nanostructures.

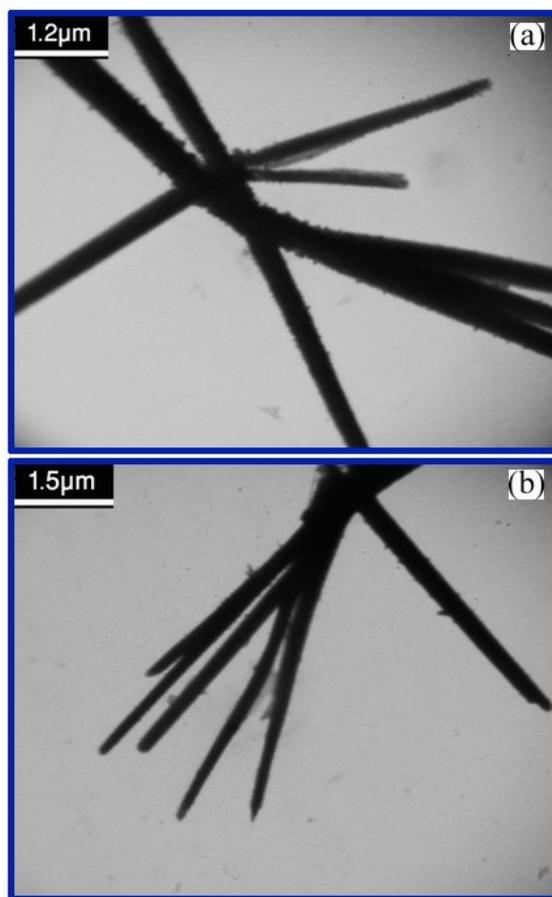


Fig. 1. (a, b) TEM images of the product synthesized by  $H_2salen$  after sonication for 15 min.

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