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Pressure effect on ZnO nanoparticles produced via laser ablation in water

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Laser ablation in liquid has attracted much attention as a relatively simple synthetic technique for the preparation of various attractive nanomaterials. Recently, a number of novel nanostructures with diverse chemistries and morphologies have been obtained via this approach in many material systems. In this work, we expand the technique, which was normally limited to atmospheric pressure, to higher (up to subcritical or even supercritical) pressures, in order to study the effect of medium pressure and prepare novel nanomaterials with unique properties. ZnO was chosen as the system to study the effect of pressure on the product as Zn plates were ablated in deionized water. A nanosecond pulsed Nd:YAG laser with the wavelength of 532 nm was used to irradiate Zn targets in a high-pressure cell. The pulse frequency was 10 Hz, and the laser power was ~30 mJ/pulse. No heating, except for locally induced by laser pulses in pressurized water, was applied, while the pressure was varied from 1 atm to ~31 MPa. X-ray diffraction, transmission electron microscopy and photoluminescence (PL) spectroscopy were used to analyze the product. As medium pressure was raised, both the product size and PL properties were found to change. More specifically, while smaller and more homogeneous in size ZnO nanoparticles were produced at elevated pressures, their UV emission peak blue-shifted and green emission was enhanced. Medium pressure is thus proved to be an efficient tool to tune the properties of nanomaterials prepared via laser ablation in liquid.

Biography

Sergei A. Kulinich is now at the Osaka University, Graduate School of Engineering. He obtained his Ph.D. degree in inorganic chemistry from Moscow State University and then was a postdoctoral fellow and research associate at the University of Tokyo (Materials Engineering), University of Quebec at Chicoutimi (Applied Sciences), and University of British Columbia (Chemistry). His recent research activities include thin films and coatings, materials and surface analysis, superhydrophobic and anti-ice surfaces, and nanomaterials (including those prepared via laser ablation).

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