Newly discovered potentials of laser ablation in liquids for energy-saving formation of solar light-driven photocatalytic materials

Tomáš Křenek[1,2] et al. *

[1] Department of Material Science and Metallurgy, Faculty of Mechanical Engineering, University of West Bohemia, Univerzitní 8, 30614 Pilsen, Czech Republic
[2] New Technologies-Research Center, University of West Bohemia, Univerzitní 8, 306 14 Pilsen, Czech Republic
*Corresponding author email: jankova@ntc.zcu.cz
*Corresponding author email: address@server.com

Laser ablation in liquids (LAL) has been developed into versatile technique producing various colloidal nanoparticles with applicable properties in e.g. biodetection, luminescence, SERS detection and photocatalysis.
Aim of this contribution is present our recent research revealing advantages of LAL for catalytic use consisting in: (i) functionalization of porous surfaces by photocatalytic nanoparticles, (ii) LAL-induced high-pressure structures with enhanced photocatalytic activity, (iii) room temperature reactive interactions between two different sols yielding photocatalytic silicides.
(i) One of the typical problems faced in the catalytic applications of colloidal nanoparticles is their instability towards aggregation, which decrease the catalytic properties. A strong effort is devoted to achieving a higher colloidal stability by various stabilizers which are, however, usually not environmentally friendly and such freely moveable nanocatalysts can enter biogeochemical cycles. It is therefore an attractive idea to make use of the adsorption of nanoparticles on rough surfaces. LAL of FeS in water produces FeS-derived colloidal nanoparticles that absorb onto immersed porous ceramic substrates and create solar-light photocatalytic surfaces. The LAL thus offers simple and **efficient way for the functionalization of porous surfaces by photocatalytic nanoparticles** that precedes aggregation in the liquid phase.
(ii) Moreover, LAL-induced FeS-derived nanoparticles contains **high-pressure orthorhombic FeS phase** which represent so far unreported example of high-pressure structures produced by LAL. High-pressure form of FeS exhibits significantly higher photocatalytic activity compared to its stable phase, which encourage next research of catalytic properties of LAL-induces high-pressure phases.
(iii) In spite of advanced research on functional colloidal inorganic nanoparticles and their reactivity, room temperature reactive interactions between two different colloids have remained challenging so far. Simple room temperature mixing of ethanol TiO- and SiO-derived colloids allows the formation of $TiSi_2$, which is the first-ever case of **room temperature reactive interactions between two colloidal species.** Inclusion of $TiSi_2$ in colloidal mixture significantly enhanced its photocatalytic efficiency for solar-light organics degradation.

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