# TEM of Photocatalytic Materials

Rostislav Medlín[1, a)], Tomáš Křenek[1], Tomáš Kovářík[1], Lukáš Vála[1], Martin Koštejn[2], Stefan Karatodorov[3], Věra Jandová[2], Veronika Vavruňková[1], Radek Fajgar[2], Josef Pola[2] and Michal Pola[1]

[1]*New Technologies Research Centre, University of West Bohemia, Univerzitní 8, 306 14 Pilsen, Czech Republic*
[2]*Institute of Chemical Process Fundamentals of the Czech Academy of Sciences, Rozvojova 135, 165 02 Prague 6, Czech Republic*
[3]*Georgi Nadjakov Institute of Solid State Physics, Bulgarian Academy of Sciences, 72 Tzarigradsko Chaussee, 1784 Sofia, Bulgaria*

[a)] Corresponding author: medlin@ntc.zcu.cz

**Abstract.** Pulsed near-IR laser irradiation of ferrous sulfide (FeS) and solid $CoS_2$ target in a vacuum, water and ethanol. FeS allows noncongruent ablation and deposition of nanostructured $FeS_{1-x}$ thin films which absorb onto immersed porous ceramic substrates and create solar-light photocatalytic surfaces. The deposition has been performed on Al, Ta and Cu substrates and the films were analyzed by scanning (SEM) and high resolution transmission electron microscopy (HRTEM) and electron diffraction. Colloids produces in liquids absorb solar light and was adsorpted to porous ceramic surfaces to create functionalized ceramic surfaces which induce Methylene blue degradation by the day light. The laser induced process thus offers easy and efficient way for functionalization of porous surfaces by photocatalytic nanoparticles which avoid aggregation in liquid phase. The formation of orthorhombic high-pressure FeS phase stable under ambient condition is the first example of high-pressure structures produced by laser ablation in liquid without assistance of electric field.

Pulsed laser irradiation of a solid $CoS_2$ target results in ablation and deposition of thin films on Ta and Cu substrate, on Ta consists of the parent cubic $CoS_2$ whereas the film on Cu exhibits a multiphase structure containing the cubic $CoS_2$ and cubic $Co_2CuS_4$. The ternary species is known as an active electrode material with relatively high energy density for electrochemical capacitors and proves interdiffusion events at the interface of copper and colliding $CoS_2$ particles. Such facile and one-step process represents the first example of the $Co_2CuS_4$ formation through ablative reactive deposition on unheated substrate and adds to very rare examples of reactive laser deposition of ablated metal sulfides on unheated surfaces. The $CoS_2$- based films deposited on Ta and the $Co_2CuS_4$ – based films deposited on Cu were examined for their catalytic effect in Fenton degradation of methylene blue (MB).

## REFERENCES

1. T. Křenek, L. Vála, T. Kovářík, R. Medlín, R. Fajgar, J. Pola, V. Jandová, V. Vavruňková, M. Pola, M. Koštejn; Novel perspectives of laser ablation in liquids: the formation of a high-pressure orthorhombic FeS phase and absorption of FeS-derived colloids on a porous surface for solar-light photocatalytic wastewater cleaning; Dalton Trans., **49** (2020), pp. 13262-13275
2. L. Vála, R. Medlín, M. Koštejn, S. Karatodorov, V. Jandová, V. Vavruňková, T. Křenek; Laser-induced reactive deposition of nanostructured $CoS_2$- and $Co_2CuS_4$-Based films with fenton catalytic properties; Eur. J. Inorg. Chem., **2019** (2019), pp. 1220-1227