Formation of catalytic nanoparticles via laser ablation in various environments and their degradation activity on methylene blue

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Abstract:

There is a great interest in the synthesis of various nanosized green reusable catalysts which would better assist various chemical reactions in wastewater technologies. Pulsed laser irradiation of iron and cobalt sulphides in different environments (FeS in water and ethanol; CoS2 in vacuum) allows laser ablation and generation of FeS, CoS2 nano/micro particles. The FeS-derived colloidal nanoparticles were absorbed onto immersed porous ceramic substrates and create solar-light photocatalytic surfaces. CoS2-based films were deposited on Ta and Cu substrate. Generated nanoparticles were analyzed using scanning electron microscopy, Raman spectroscopy, X-ray photoelectron spectroscopy, high resolution electron microscopy and electron diffraction. These complementary analyses revealed that the film on Ta consists of the parent cubic CoS2 whereas the film on Cu exhibits a multiphase structure containing the cubic CoS2 and cubic Co2CuS4. In a case of FeS analysis reveal high-pressure orthorhombic FeS, cubic magnetite Fe3O4 and tetragonal maghemite γ-Fe2O3 produced in water, while those formed in ethanol contain hexagonal FeS and cubic magnetite Fe3O4. FeS-derived and CoS2-based nanoparticles were examined for their catalytic effect in Fenton degradation or photodegradation of methylene blue (MB).

Key words:

Pulsed laser ablation, iron and cobalt sulphides, Fenton degradation, photodegradation, catalysis