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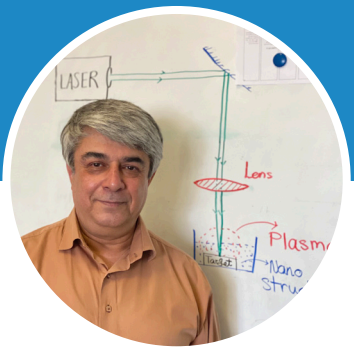
Review on lasers synthesis and processing of nanostructures



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Lasers are one of the effective tools to improve material processing. The laser beam cuts thick metals more finely than any cutter machine. The laser beam drills thick steels more accurately than any drill. Without lasers, welding technology was imperfect. Furthermore, printing, forming, and holograming are other roles of lasers in material processing. The present century began with the rapid development of nanotechnology, which opened new fields for laser applications in material science.

In this short review, I am going to present my works on laser synthesis and processing of nanostructures include nanoparticles (Au), nanocomposites (TiO_2), nanoalloys (Au/TiO_2), MOFs (MOF5; metal-organic framework compound with the formula $Zn_4O(BDC)_3$) and graphene. The physical mechanisms, responsible for production of different forms of nanostructures will be discussed in detail. The fundamental wavelength/second harmonic of Nd-YAG laser at 1064 nm/532 nm and 7 ns pulse width was employed to carry out the experiments via pulsed laser ablation process in liquid environment. The laser fluence, repetition rate, as well as the liquid environment are powerful tools by which the regime of laser ablation and the ablation products can be controlled.

Variety of diagnostics were employed to study the characteristics of nanostructures after their production. UV-Vis-NIR absorption and transmission spectroscopies were used to investigate the optical properties of nanostructures. Their molecular bonds and crystalline structure were studied using FTIR spectra and X-ray diffraction pattern respectively. And size and morphology of synthesized nanostructures were observed by TEM and SEM images.

Results confirm that pulsed laser ablation in liquids (PLAL) is a capable method to synthesize different forms of materials in nano dimension. PLAL is a friendly environment and easy method for material processing in atmospheric pressure. Composition, size, morphology, and other properties of nanomaterials can be easily controlled by PLAL parameters such as laser wavelength, laser pulse width, laser spot size, as well as liquid environment parameters.

Biography

Davoud Dorranian received the BS degree in applied physics from the Urmia University, Urmia, Iran in 1992 and MSc degree in atomic and molecular physics (plasma physics, MCF) from I. Azad University, Tehran, Iran in 1995. He graduated with a PhD in Utsunomiya University, Utsunomiya, Japan in 2003. His PhD research was an experimental work on the radiation phenomena in the interaction of high-power ultrashort pulsed laser with plasma. He then joined the Plasma Physics Research Center of I. Azad University in Tehran, Iran, where he is now full professor. Since 2005 he has been the editor-in-chief of the Journal of Theoretical and Applied Physics. His research activities have been concentrated on the study of nanosecond laser pulses and materials with the focus on the laser ablation produced nanostructures. Theoretically, he works on the interaction of high power lasers with plasma and waves in plasmas.

SPEAKER