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論　文　内　容　要　旨

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学位論文題目	Probing the Optoelectronic Behavior of 2D Nanomaterials Synthesized by Laser Ablation and Hydrothermal Method (レーザーアブレーションと水熱法により合成した２次元ナノ材料の光電子特性の研究)		

内容要旨

Synthesis of well-faceted tungsten suboxide prepared by laser ablation in a liquid medium. The tungsten disulfide (WS_2) was used as bulk material while mix of water and ethanol was used as a solvent. Laser ablation was carried out using ns second Nd:YAG laser (second harmonic, 532 nm) with output power of 600 mW and ablation time of 20 minutes. Structural properties and morphological features of WO_{3-x} were analyzed by UV–Vis spectroscopy, FE-SEM, EDS, and XRD. The UV-Vis spectra and EDS spectra revealed the formation of sub-oxide tungsten oxide. While XRD spectra indicated that bulk WS_2 was transformed into sub-oxide tungsten oxide (WO_{3-x}). SEM images demonstrated a self-assembled petal-like flake structure made up of ultra-thin nanosheets with a thickness of less than 20 nm. It is suggested that a well-defined WO_{3-x} petal-like nanosheet could be useful for promising applications in optoelectronic devices. Also, tungsten suboxide/tin oxide(WO_{3-x}/SnO_2) composites were successfully prepared via laser ablation and synthesized WO_{3-x}/SnO_2 binary composite was used as photocatalyst for photodecomposition of methylene blue (MB). Binary composites exhibited higher photocatalytic performance under LED light irradiation than WO_{3-x} and SnO_2. Obtained materials were characterized by EDS, FE-SEM, and UV-Vis spectroscopy and XRD. UV-Vis spectroscopy suggests formation of tungsten suboxide, crystalline SnO_2 nanoparticles, and visible region absorption of composite suggesting suitability for photocatalytic activity. SEM images of WO_{3-x}/SnO_2 revealed that SnO_2 octahedron crystals were deposited on the petal-like structure of WO_{3-x}. Further, elemental mapping was performed using EDS to confirm presence of WO_{3-x}, SnO_2, and WO_{3-x}/SnO_2 binary composite. XRD peak position matching with JCPDS standards confirms the formation of the binary composite. Enhanced photocatalytic performance of the WO_{3-x}/ SnO_2 composite can be directly accredited to the presence of SnO_2, which may lead to an increase in the separation efficiency of electron-hole pairs. The 84.4% of MB removal was achieved after 60 minutes of illumination compared to 41.58% synthesized SnO_2 and 25.38%of WO_{3-x}. It was one of the most photoactive WO_{3-x} based photocatalysts for MB photodecomposition. Also synthesized WS_2/GO/Au ternary composite by WS_2 and GO using nanosecond laser ablation followed by adding Au using the hydrothermal method. UV-Vis, Raman, XRD, and FE-SEM were used to investigate microstructure, morphology, and spectroscopic properties of samples. UV-Vis spectra suggest formation of ternary composite, FE-SEM shows morphology as Au nanoparticles with size ranging from 20-30 nm are perfectly mixed with WS_2 nanosheets which can be seen on GO sheets. EDS-SEM images indicate availability of all elements in prepared samples and formation of ternary composite of WS_2/GO/Au. XRD and raman spectroscopy confirm crystalline nature of AuNPs and WS_2 and suggest the transformation of GO into rGO. Prepared pristine(WS_2), binary(WS_2/GO) and ternary composite show capability for MB degradation under UV-light irradiation as 41.85%, 48.27% and 83.17% respectively. Improved photocatalytic activity by multicomponent has been demonstrated by nanostructured catalysts with specific morphology due to their exceptional electron transport characteristics.