

Structural modification of 12-thungstophosphoric acid by ion beam irradiation

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Polyoxometalates are a large group of transition metal oxides with characteristic complex structures and interesting physicochemical properties that are important in catalysis, sensing and storage of energy. The 12-thungstophosphoric acid (WPA) is typical heteropolyanion; it is composed of 12 WO₆ octahedrons that are placed around central PO₄ tetrahedron (PW₁₂O₄₀³⁻). This structure, known as Keggin anion, has multiple redox reactions that are very useful in electrochemical charge storage applications.

In present study, we have investigated effects of ion beam irradiation on structural properties of WPA. The WPA films (~120 nm) were irradiated with 10 keV C⁺ ions at fluencies between 5×10^{14} and 2.5×10^{15} ions/cm². As-prepared and irradiated samples were characterized by attenuated total reflectance-Fourier transform infrared spectroscopy (ATR-FTIR), Raman spectroscopy and UV-Vis diffuse reflectance spectroscopy. Characteristic bands of the Keggin anion structure were observed in ATR-FTIR and Raman spectra of as-prepared samples. Shifting and broadening of these bands was observed for irradiated samples, indicating structural changes in WPA. UV-Vis diffuse reflectance spectroscopy of irradiated samples showed changes in the spectra of WPA and increase of band-gap. The obtained results suggest that ion beam irradiation with 10 keV C⁺ ions at the lower fluencies alters WPA structure while higher fluencies cause amorphization of Keggin anion.

Primary author: Mr MRAVIK, Željko (Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia)

Co-authors: Dr MRAKOVIĆ, Ana (Laboratory of Theoretical Physics and Condensed Matter Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia); Dr BAJUK-BOGDANOVIĆ, Danica (Faculty of Physical Chemistry, University of Belgrade, P.O. Box 47, 11158 Belgrade, Serbia); Dr PERUŠKO, Davor (Laboratory of Atomic Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia); Mr TRAJIĆ, Ivan (Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia); Mr VUKOSAVLJEVIĆ, Ljubiša (Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia); Dr JOVANOVIĆ, Zoran (Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, Belgrade, Serbia)

Presenter: Mr MRAVIK, Željko (Laboratory of Physics, Vinča Institute of Nuclear Sciences, University of Belgrade, P.O. Box 522, 11001 Belgrade, Serbia)

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