EFFECT OF EXTRATERRESTRIAL SOLAR UV RADIATION ON STRUCTURE AND PROPERTIES OF ZnO FILMS OBTAINED BY WET CHEMICAL METHODS

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Sunlight in space at the top of Earth's atmosphere, which is named as extraterrestrial solar radiation, contains of about 10% of ultraviolet light (UV) with a wide range of wavelengths (λ), mostly with λ = 100-399 nm, having total UV intensity of about 140 W/m^2. Solar long-wave (315–399 nm) ultraviolet A (UVA) is not absorbed by the ozone layer and arrives the Earth's surface, but short-wave (100-279 nm) ultraviolet C (UVC) is completely absorbed by the ozone layer and atmosphere. Influence of solar UV radiation on different materials is manifested in photochemical reactions which lead to the photodegradation. However, pure and doped wide band gap semiconductor zinc oxide films and nanostructures have to work under the influence of solar UV radiation, including in solar cells and other optoelectronic devices for space applications. In addition, ZnO nanostructures are commonly used in the reflective coatings for the external spacecraft surfaces.

The research of effect of UVA and UVC light on the nanostructured zinc oxide arrays, which were grown by pulsed electrodeposition, as well as on the ZnO and ZnO:In films produced by Successive Ionic Layer Adsorption and Reaction (SILAR) method confirmed their suitability as UVA-active photosensitive materials. Thereafter, we analyzed an influence of UVC on crystal structure, optical and electrical properties, namely on the thermal activation energy of electrical conduction, on the thermoelectric characteristics and on the photosensitivity range of the ZnO and ZnO:In films. As shown by the results of XRD, SEM, XRF and optical spectrophotometry investigations, the crystal structure, surface morphology, chemical composition and optical properties found no obvious significant destructive changes after UVC irradiation. However, we detected some irreversible changes in the nature of point defects under the influence of UVC, which affect the ZnO and ZnO:In resistivity, activation energy, photosensitivity and thermoelectrical properties. As was shown, the effect of the UVC irradiation can be explained as the halving of shallow donors when the zinc interstitials Zn_i, Zn_i^+ and Zn_i^{++} and indium interstitial In_i take the sites of oxygen vacancies V_O^+, thus creating zinc antisite and indium antisite, respectively.