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A three-stage mechanism of ZnO nanoparticles formation at the surface of ZnO crystal by laser radiation

A three-stage mechanism of ZnO nanoparticles formation at the surface of ZnO crystal by the forth harmonic of Nd:YAG laser radiation is proposed. The first stage is intensive generation and concentration of Zn interstitials at the irradiated surface of ZnO crystal by the laser. The second stage is agglomeration of Zn interstitials to Zn nanoparticles with the size depending on the number and intensity of laser pulses. The third stage is transformation of the Zn nanoparticles into ZnO nanoparticles due to oxidation of Zn nanoparticles in atmospheric environment using the same laser radiation. An evidence of Zn phase formation in ZnO crystal is appearance of 70 cm-1 band in Raman spectra after irradiation by the first and the second laser pulse. A new broad band at 561 cm-1 in Raman spectra is observed after irradiation by 5 laser pulses. The intensity of the band increases with the number of laser pulses and at the same time the intensity of the 70 cm-1 band decreases until it disappears. The nature of the band is connected with oxidation of Zn nanoparticles. It is the third stage of ZnO nanoparticles formation. Comparison analysis of the proposed laser method with the conventional methods of nanoparticles formation in semiconductors will be carried out.

Biography

Arturs Medvids obtained the degree Dr. Habil. Phys., specializing in Solid State Physics at Latvian University, Riga. He has been the Head of Laboratory of Semiconductor Physics at Riga Technical University since 1989. He was a Professor at the Institute of Technical Physics of Riga Technical University since 1995. In 2001, he worked in Japan as an Invited Professor in Shizuoka University. He was awarded the title of Honourable Guest Professor of Shizuoka University, Japan, in 2009, 2014 and 2016. He has published more than 560 scientific publications which includes papers, conference proceedings, books and patents.

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