APPLIED ASPECTS OF THE RADIATION TECHNOLOGIES IN SOLID STATE MATERIALS

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At the Institute of Nuclear Physics are conducts fundamental and applied researches in the field of radiation physics and materials on the basis of next unique research facilities: gamma facility, neutron generator NG-150, electron accelerator "Electronics U-003" and nuclear reactor WWR-SM using optical, electrical, diffraction, spectrometric and other methods.

Silicon research revealed that the hydrogen passivation of neutron-doped silicon, the dislocation density and the concentration of structural vacancy-type defects are reduced 1,5 ç 2-times compared with non-hydrogenated silicon. Dominant radiation defects, which responsible for the degradation of silicon SE is divacancy level with E_c-0.39 eV and E_v + 0.31 eV, due to the complex (V-O-C). The optimal regimes of radiation and thermal processing established for receiving silicon with a nominal specific resistance in the interval of $(4–8)\cdot10^4$ Ohm·cm for the manufacture of nuclear radiation detectors and thermistors which are working as a thermal switch for operation in the range (55 - 115)°C. Study of single crystals and optical ceramics based on BaF-Ce found that in single crystals, starting with a dose of gamma irradiation 10^5 Rad, creates color centers which are associated with uncontrolled impurities of hydrogen and OH groups, and optical ceramics are radiation resistant up to 10^8 Rad dose.

At gamma facility with a total activity 50000 Curie (radiation source ^{60}Co) and electron accelerator with a maximum energy of 8 MeV and a beam current up to 1A developed the technologies to increase the operation speed, management parameters of semiconductor devices and integrated circuits. On the basis of the optimal combination of energy, electrons flux density and absorbed dose the operation speed of diodes has been increased from 150 ns to 15 ns. With the use of gamma radiation developed technology to increase of operating characteristic and extend of spinneret durability used in the industry. Also performs studies to improve of the nanocoating properties by radiation. In particular, structures studied and radiation treatment conditions are identify which resulting in an increase of microhardness in TiHfSiN, TiZrSiN (integral electron fluencies 10^{16} ç 10^{17} el/cm^2). Developed technology for radiation coloration of jewels topaz, beryl, morganite with irradiation on gamma facility powerful channel (~600 R /s) and subsequent their heat treatment. At present time works are holding on coloration of Beryl and Topaz stones at electron accelerator. Investigations on technology development to radiation sterilization of materials, products and raw materials for medicine and pharmacy carried out. On base of perform studies, the technology of silk surgical thread sterilization (20.0 kGy), simple and chrome catgut thread sterilization (sterilization dose 25 kGy) with minimal (up to ~ 13%) changes in thread strength and a simple surgical site are developed. After 8 months of radiation sterilization, the value of the breaking load of the non-woven material along the length was 116.3 N, and the width 44 N that demonstrating about of the non-woven material strength are small changes compared with original. The optimal sterilization dose of sedative Sedonik (powdered herbs) and packaging gelatine capsule is 20 kGy, the electron beam current density - 0.03 μA/cm^2 and the electron energy ~5 MeV. It is established that corn and potato starches sterilized (20 kGy dose) at electron accelerator preserves of sterility and colour for 12 months.