Poster Presentation

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New applications of sapphire crystals

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Results of studies of sapphire as a prospective material for different modern applications are presented. An analysis of different growth techniques was performed and a crystalline surface treatment technique developed. Processes of high-temperature surface recrystallization have been studied and the structure of dislocations in the crystals examined. Some applications for sapphires are shown. The following techniques were applied: RHEED, AFM, HRTEM, X-ray scattering, topography, and tomography, using both x-ray tubes and synchrotron radiation sources. High-temperature annealing of super-smooth sapphire surfaces (RMS roughness < 0.2 nm) produces terrace-step structures on the surface. The influence of the miscut parameters and annealing conditions on the structures is analyzed. The substrates with such surface structures were used to form regular ensembles of gold nanoparticles and for the epitaxy processes of AIIBVI thin films. The availability of sapphires that are perfect from the X-ray optics point of view can overcome major limiting factors for meV resolved nuclear resonance scattering and other high energy-resolution X-ray spectroscopy techniques. The analysis made by different X-ray topographic methods shows that the presence of dislocations limits the size of useful reflective area of the crystal. It is shown, that only Kyropoulos-grown crystals demonstrate very low dislocation densities, as low as 100 cm^-2, and the most narrow backscattering spectral reflectivity band. This work is supported by the Russian Foundation for Basic Researches (Grants № 13-02-01065a and 13-02-91325), Presidium of the Russian Academy of Sciences (Program №24) and Helmholtz association of German Research Centers (HRJRG-402 project). We thank A. Danilewsky, J. Härtwig, A. Muslimov, I. Prokhorov, A. Vasilyev, V. Vlasov for their assistance as well as principal investigators of the project: A. Chumakov, H.-C. Wille, I. Sergueev, S. Stankov.

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