SYNCHROTRON RADIATION IN MATERIALS DIAGNOSTICS

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The synchrotron radiation (SR) is a powerful instrument for materials diagnostics. At the last decade progress in this area was determined by progress in development of new specialized generator of synchrotron radiations - wigglers and undulators, installed at 3-th generation storage rings [1]. So brilliance of SR is 10^{23} (photons/sec/mm^2/mrad^2 in 0.1% bandwidth) now and will reach 10^{35} (photons/sec/mm^2/mrad^2 in 0.1% bandwidth) in the nearest future.

High brilliance allows to realize the high time resolved diffraction experiment with nanosecond time resolution now [2] and femto- second time resolution in the nearest future. There are no chance to realize such experiments with using commercial X-ray devices. High time resolved diffraction experiment needs high count rate position-sensitive detectors, which developed in last decade with big progress in Budker Institute of Nuclear Physics SB RAS.

Using of this method for materials synthesis allows to receive new, inaccessible earlier information - about phase transformation in chemical reaction zone, about formation of an intermediate phases, about behavior of the reagents crystalline lattice before reactions, and about relaxation process after reaction. The SR was used in Siberian synchrotron radiation center for investigation of:

- self propagation high temperature synthesis with millisecond time resolution;
- self assembling of Ag nanoparticles (6 nm) in 3D crystals (25 micrometers size);
- self assembling structure for catalysis;
- explosion synthesis of nano-particles of diamond and metals with nanosecond time resolution;
- quantum dots and metal clusters;
- nanoparticles behavior in extreme condition of high temperature and pressure;
- thin films.

The progress in generations of SR opens the new possibilities for use of SR for material diagnostics: locality - 100 nm, time resolution - 1 femtoseconds, depth of the penetration of the radiation - 1 sm.

References

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