4.3.7. SYNCHROTRON EMISSION FOR NON DESTRUCTIVE TESTING AND NANODIAGNOSTICS

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Synchrotron emission due to its unique characteristics (enormous brightness, wide spectral range, collimation, coherence, polarization, peculiar temporal pattern and others) provides special capacities for non-destructive testing and local structural diagnostics of wide scale range objects from nanometers to dozens of centimeters.

For example, new (in comparison with absorption X-ray radiography) inner imaging methods based on detection of fine X-ray optical effects such as deflection (refraction), phase contrast, diffraction, small-angle scattering and others, are implementing based on synchrotron emissions. It makes possible to visualize details of inner structure of an object such as inner interface, single sporadic crystalline defects, microstress, acoustic vibrations, phase content discontinuity and others which cannot be detected by the classic radiation control methods.

Synchrotron emissions are especially significant for structural diagnostics and metrology of nanosystems and nanomaterials, particularly for nanocoating, heterostructures, superrays, nano-disperse medium, microelectromechanical and nanoelectromechanical systems, nano-biorganic coating and others. For this purpose X-ray optical methods were developed based on standing X-ray waves, total external reflection, diffusion scattering, X-ray topography, microtomography and holography. Acquired information is important for optimization of nanosystems and materials molecular engineering.

Presently, non-destructive X-ray testing and nanodiagnostics methods are rapidly developing based on Kurchatov synchrotron emission source (KSES) which operates in multiple access mode and serves as a metrological and diagnostics platform for emerging convergent technologies center in the Russian Research Center “Kurchatov Institute”.