# Nanoscale optical coherence tomography using soft X-ray and extreme ultraviolet radiation sources based on laser-irradiated double stream gas puff targets.

**Keywords: Soft X-rays, Extreme ultra-violet, optical coherence tomography, X-ray optics, X-ray spectroscopy, Laser produced plasma**

With the advancement of nanotechnology, the ongoing process of miniaturisation is rapidly driving into a few nanometres' regime. Nanotechnology now encompasses vast areas of the field of science and technology including semiconductor technology, photonic circuits, biological intracell structure identification, biomedicine, thin film, and multilayer technologies. In such a scenario there is an enormous demand for solutions in the non-destructive testing (NDT) with nanometric resolution.

Optical coherence tomography (OCT) is 3-D imaging technique popular in medicine for measuring the thickness of retinal layers and blood vessels layers. OCT uses radiation in the optical frequencies for its operation. Optical coherence tomography technique cannot be used to image of opaque objects and a typical OCT method has an axial resolution of 1 μm. A novel OCT method based on the use of short wavelength radiation has been proposed to implement this technique to 3-D measurement of nanometric layer structures.

**In this project we will demonstrate non-destructive testing of the internal structure of multilayer nanostructures using a newly developed X-ray coherent tomography (XCT) system based on a laser produced plasma source of soft X-rays and extreme ultraviolet and focusing optics.** In the XCT system the spectral domain optical coherence tomography method has been used. It allows achieving an axial resolution in the nanometer range. The XCT system will be applied for the tomographic imaging of the specially designed and fabricated test sample for the NDT studies. The 3-D images of the test sample will be reconstructed using a new advanced algorithm based on 1-D phase retrieval method developed under the project. Such a reconstruction method is warranted due to the problem of the presence of artifacts in reconstructed depth image.

The XCT technique has the capability of measuring depth of multilayer structures with an axial resolution of 2 nm that was recently demonstrated using 1-D samples. The present project aims to extend the technique to tomographic imaging of 3-D nanostructured samples. The XCT technique has a high potential for applications in the non-destructive testing of nanoelectronics and nanophotonic elements in the manufacturing processes, and investigation of the internal structure of biological cells with nanometric resolution. Previously demonstrated XCT systems were based on synchrotrons and femtosecond laser systems while the present technique will allow to measure 3-D nano structures with nanometer axial resolution by utilising commercially available compact nanosecond lasers.