Application of X-ray microscopy in materials science and nanotechnology

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X-ray imaging and X-ray computed tomography (XCT) provide non-destructive characterization capabilities on opaque objects, observing features with sizes spanning from millimeters to micrometers down to several 10 nanometers. Currently, two types of laboratory-based XCT setups are available commercially for imaging at medium and high resolution: micro XCT in projection geometry with a resolution of about 1 µm and nano XCT with focusing X-ray lenses with a resolution down to about 100 nm [1]. X-ray microscopy and nano XCT are potential techniques for nondestructive imaging of bulk materials and complex thin film structures. Examples for high-resolution X-ray imaging studies will be shown: reliability studies of microchips, kinetic reactions for energy storage and crack propagation in composites.

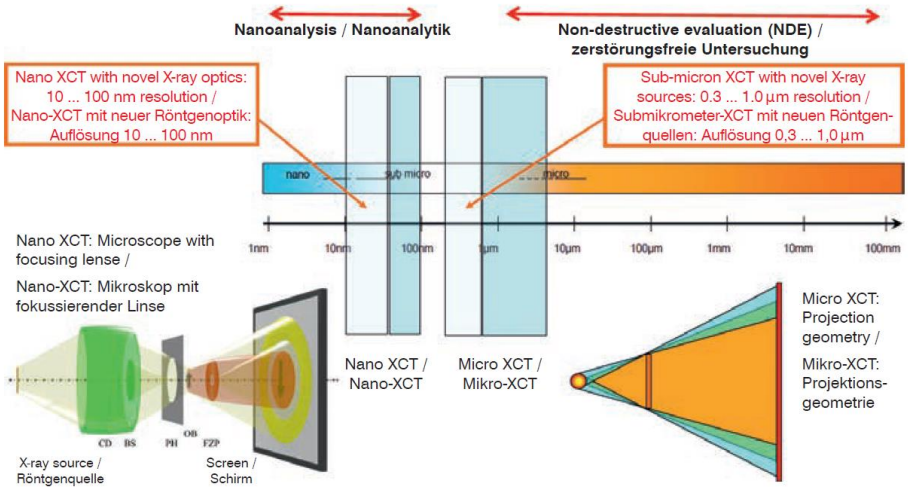

Fig.1 Imaging schemes for micro XCT and nano XCT and resolution ranges, today and expected future developments (3-5 years) [1].

Novel focusing lenses, so-called multilayer Laue lenses, have the potential to bring hard X-ray microscopy (high photon energy) to resolutions down to the 10 nm range and below, since - compared to the fabrication of state-of-the-art Fresnel zone plates - the resolution is not limited by the patterning process [2].

References

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2. S. Niese et al., Optics Express **22**, 20008 - 20013 (2014)