A scanning microscope using laboratory X-ray sources

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Currently high-resolution static X-ray microscopy is mainly performed with synchrotron radiation [1,2] or laser plasma sources [3,4]. Recently EUV transmission microscopy with high-harmonic radiation was demonstrated with a resolution of better than 400 nm [5]. Here we present a compact scanning transmission microscope developed for EUV and soft X-ray laboratory sources, including high-harmonic sources[6]. With a laser plasma source the resolution of the scanning microscope is determined to 500 nm at λ = 17 nm.. This is close to the theoretical resolution of 350 nm. With the new technique of high-harmonic generation the way is paved to examine highly dynamical processes. applying visible-pump and X-ray-probe techniques, time-resolved photoelectron or X-ray fluorescence spectroscopy. We demonstrate first results of the scanning transmission microscope using plasma and high-harmonic radiation for imaging different objects.. The 13 nm and 17 nm oxygen lines of a laser plasma source and the 61st harmonic of a laser based high-harmonic radiation source have been used. The high-harmonic source was driven by 25 fs/1 mJ pulses of a Ti:sapphire laser. To ensure a uniform, monochromatic illumination the radiation is spectrally narrowed with filters and/or a Mo/Si multilayer mirror optimised for 13 nm. The set-up of the microscope can easily be modified for imaging in the water-window region between the K absorption edges of oxygen and carbon (2.34 - 4.38 nm). This spectral region is especially adapted for biological and medical investigations and desperately waiting for suitable high resolution laboratory microscopes.

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