

IMAGING IN NANOSCALE USING LASER-PLASMA SOURCES OF EXTREME ULTRAVIOLET (EUV)

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Recent rapid developments of nanoscience and nanotechnology require nanometer scale resolution imaging tools and methods. One of the methods, extensively studied for the last few decades, is an extreme ultraviolet (EUV) and soft X-ray (SXR) microscopy, based on Fresnel zone plates. The introduction of compact sources of bright EUV and SXR radiation paved the way for the development of tabletop microscopes that can render images of nanoscale objects with exposures as short as a few seconds and spatial resolution approaching that of synchrotron-based microscopes [1, 2].

In this paper, we report on applications of a desk-top microscopy using a laser-plasma EUV source based on a gas-puff target for studies of morphology of thin silicon membranes coated with NaCl crystals and ZnO nanowires. Previously measured spatial resolution of this microscope, reaching 50 nm, allows for acquisition of images of various objects with high spatial resolution and field of view approaching $50 \times 50 \mu\text{m}^2$ in a very compact setup. Utilization of the short wavelength EUV radiation allows to demonstrate the intrinsic advantage of this radiation for extraction of additional information about the investigated object, which cannot be obtained directly from optical micrographs and SEM images. Moreover, this microscope does not require additional sample modification necessary for SEM microscopy.

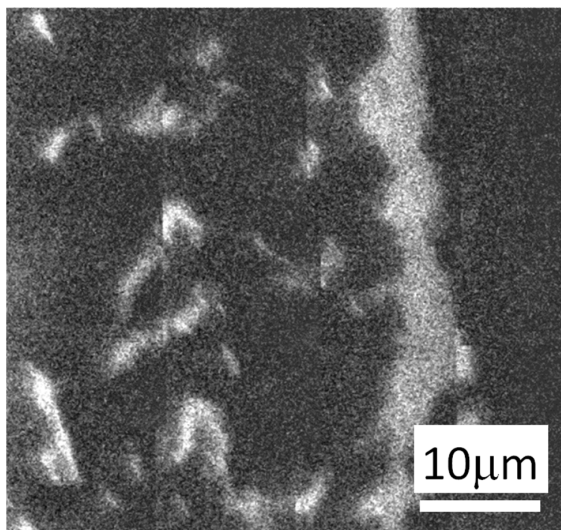


Figure 1: EUV image of the sample, $\sim 50 \times 50 \mu\text{m}^2$ with re-crystallized NaCl.

Both, NaCl coated membranes and ZnO coated polymer nanowires were imaged using an EUV microscopy setup, reported previously in [1, 2]. NaCl was crystallized on a 15 nm thick non-porous silicon membrane (SPI Supplies) with dimensions $0.07 \times 1.5 \text{ mm}^2$. The NaCl crystals were prepared from phosphate buffered saline (PBS) solution. During the process of re-crystallization stress was introduced to the membrane causing random cracks of various sizes to appear in the NaCl crystals and the silicon membrane. Sample EUV image of cracks in the membrane are presented in Fig. 1. ZnO coated polymer nanowires were prepared by electrospinning on top of a gold mesh. Later they were annealed at 500°C for 4 hours. Sample image of ZnO coated nanowires are presented in Fig. 2.

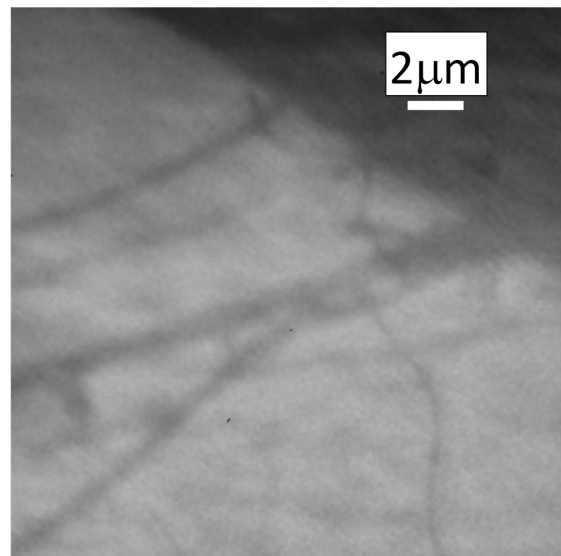


Figure 2: EUV image of the sample, $\sim 20 \times 20 \mu\text{m}^2$ with ZnO coated polymer nanowires.

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References

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