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New setup for in-situ MBE growth studies using high energy x-ray diffraction

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In the past, the structure of thin epitaxial films has been studied extensively by hard x-rays using dedicated systems at various synchrotron beamlines for in-situ studies [1,2]. The typical time scale for these experiments has been rather high forcing these studies to focus either on a rather limited parts of reciprocal space [3] or to accept rather poor time resolution. Using high energy x-rays, however, surface diffraction is able to record huge maps of reciprocal space during catalytic reactions within a few seconds [4].

Here, we present a new setup to extend high energy x-ray diffraction (HEXRD) to in-situ studies of thin epitaxial film during molecular beam epitaxy (MBE) with high time resolution while large parts of reciprocal space are recorded. Thus, real time studies during MBE are possible. The deposition chamber is mounted on the surface diffractometer at the high energy material science beamline P07 at PETRA III. During the experiment, the sample is moved by the diffractometer while the chamber is fixed. In addition to structural investigations, a hemispherical electron spectrometer is implemented for complementary x-ray photoelectron spectroscopy (XPS) measurements.

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[2] C. Nicklin et al., J. Synch. Rad. 23, 1245 (2016)

[3] O. Kuschel et al., Appl. Phys. Lett. 111, 041902 (2017)

[4] J. Gustafson et al. Science 343, 758 (2014)

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