Disentanglement and control of coherent and incoherent surface deformations

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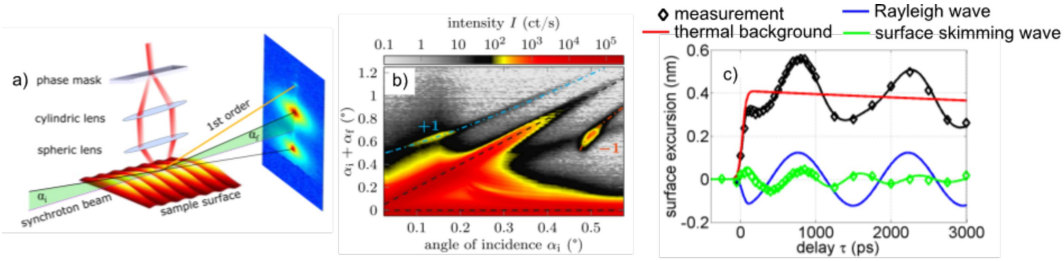
We present time-resolved x-ray reflectivity (trXRR) measurements of laser excited coherent and incoherent deformations at the surface of thin metallic films. The experiment is shown in Figure a). Based on a kinematical diffraction model we extract the absolute surface amplitude from the diffracted x-ray intensity of the +1/-1 diffraction order [cf. Figure b)].[1] Synchrotron-based measurements yield sub-Å precision and a temporal resolution of 70 ps. trXRR measurements allow for decomposing the surface excursion into a thermal background and two coherent acoustic modes [cf. Figure c)], namely a surface acoustic Rayleigh wave (SAW) and a surface skimming longitudinal wave (SSLW).

By employing a second optical excitation, we perform coherent control of the acoustic modes and of the incoherent thermal grating.[2] The latter is achieved by variation of the relative spatial phase of first and second optical excitation. In recent experiments we demonstrate full control of the surface deformation by modulating amplitude and phase of each coherent and of the incoherent excitation individually.



a) Experimental setup, b) trXRR measurement showing the specular reflection and +1/-1 diffraction from the laser-generated transient surface grating. c) Decomposition of the transient surface excursion into a thermal background and two coherent acoustic modes.

References

[1] M. Sander et al., Appl. Phys. Lett., 111, 261903 (2017)

[2] M. Sander et al., Phys. Rev. Lett., 119, 075901 (2017)