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Contact line dynamics on moving fibres measured by X-ray holography

The wetting properties of solid surfaces are extremely important for many daily and industrial processes, like for example inkjet printing, painting, and adhesion of bacteria or viruses on catheter and medical devices [1]. While significant progress has been made in describing the static properties of drops on surfaces, the wetting dynamic is less understood. In particular, the dependence of the characteristic receding and advancing contact angles on velocity cannot be quantitatively described so far. It is furthermore under debate whether the contact line is disturbed by pinning at nanoprotusions and whether this is accompanied by pinching of nanodroplets. At high velocities the interfacial tension might cause that the contact line slides over the topological defects. Most experimental studies hereby rely on optical or confocal microscopy and thus lack the combined spatial and temporal resolution to distinguish these scenarios [2,3].

We present data from X-ray phase contrast imaging experiments, imaging the three-phase contact line of an aqueous solution on a moving glass fibre in transmission geometry. We used the GINIX nanofocusing setup [4] at the P10 beamline at PETRA III (DESY, Hamburg). In our experiment, we achieved a spatial resolution of around 500 nm and a temporal resolution of 10 Hz. We measured the contact line using water and different water-glycerol mixtures as liquid. A glass fibre of about 17 ⌧ thickness (clean as well as PDMS coated) was pulled out of the liquid bath with a velocity in the range of 0.1 mm/s to 25 mm/s by a programmable motor. We observed clear changes in the contact line in relation to the velocity and the viscosity of the aqueous solutions with a high spatial resolution.

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