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Shear flow in spray-deposited cellulose nanofibril dispersions

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Fabricating functional material relies on non-equilibrium hydrodynamic flows. Spray deposition using atomization of complex liquids leads to a deposition of droplets on a substrate. The solvent evaporates and induces a complex flow in the dispersion. This leads to a nanostructuring of the nanoscale ingredients of the dispersion. Using cellulose nanofibrils and water as solvent, we have recently established sprayed ultra-smooth nanopaper. Its response to humidity was elucidated via in situ grazing incidence small-angle neutron scattering (GISANS) at KWS-1. Different surface charges of the CNF lead to different nanostructuring owing to the electrostatic repulsion of the CNF. We could find that the cellulose fibrils form a densely packed network with radial distribution to the outer sample regions Yet, the observation of the emerging of the ordering at the liquid-solid interface is hitherto not accessible. Hence, in order to understand the complex flow mechanism in the liquid droplet, we aim in investigating the interfacial shear induced self-assembly mimicking the droplet-substrate interface. Our aim is to understand the formation of the first mono-/bi-layer of CNF suspension on a hard substrate (silicon) as first step of nanopaper formation by applying in situ rheometry.

Primary authors: Dr BRETT, Calvin (DESY & KTH); Prof. SÖDERBERG, Daniel (KTH Royal Institute of Technology); FRIELINGHAUS, Henrich (JCNS); MÜLLER-BUSCHBAUM, Peter (TU München, Physik-Department, LS Funktionelle Materialien); ROTH, Stephan (DESY / KTH)

Presenter: ROTH, Stephan (DESY / KTH)

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