

## Physics Seminar

Tuesday, 13<sup>th</sup> December at 16h15

(coffee at 16h00)

Campus Belval  
Room F011

Talk by Prof. Christian Wagner  
Universität des Saarlandes

### The blistering of viscoelastic filaments and the formation of nano-fibers

When a polymer solution experiences capillary thinning, the finite time singularity of the pinch off process is suppressed and an almost uniformly cylindrical thread is formed. The reason for this effect is the high resistance of polymers against elongational flow that leads to the so called elongational viscosity. Capillary thinning is one of the few experiments that allow the determination of this material parameter. Still, there exists no satisfying constitutive theory that describes e.g. shear and elongational flow consistently. We present measurements on a variety of different flow types that shall help to identify the relevant scaling laws.

In the last stages of thinning, when polymers have become fully stretched, the filament becomes prone to several instabilities, e.g. a “breathing” instability, originating from the edge of the filament, and a sinusoidal instability in the interior, which ultimately gives rise to a Rayleigh Plateau instability followed by a blistering pattern of beads on the filament. Preliminary micro-PIV measurements indicate the existence of irregular flow fields. For sufficiently high polymer concentrations, the filament eventually separates out into a solid phase of entangled polymers, connected by fluid beads. A solid polymer fiber of about 100 nanometer thickness remains, which is essentially permanent.

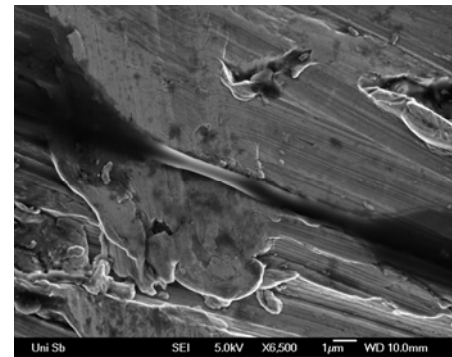
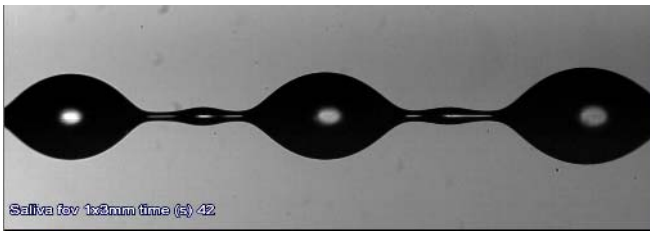


Fig1, left: viscoelastic filament of a sample of human saliva with the beads on a string pattern that follows from the Rayleigh Plateau type instability. Right: Scanning electron microscope images of the final remaining polymeric nano fiber of the same sample.

### Next Physics Seminars

- Friday, 16<sup>th</sup> December 2011  
Limpertsberg 10h30  
Prof. Michel Pleimling  
*Aging processes in materials far from equilibrium*
- Thursday, 12<sup>th</sup> January 2012  
Belval, 14h00  
Dr. Tobias Kraus  
*Particle films, clusters and supercrystals: the science and the process engineering of nanoparticle self-assembly*