Delivery and spraying of biofluids and interaction of droplets with porous materials

Many engineering applications assume generation of single spherical droplets on demand. Piezo- and thermo droplet-on-demand instruments are not able to produce droplets with a broad range of size distributions from the same nozzle. We use the principles of electrostatic generation and capillarity to resolve this challenge. A thin conductive wire threaded through a needle can be used as the droplet electrogenerator . Applying a weak-bias electric field, one can deliver a drop from the needle edge to the free wire tip. Detachment of a pendant drop from the wire is then achieved by applying a short voltage pulse. Using the wire-in-a–needle nozzle, we were able to produce single droplets ranging from 50 µm to 500 µm, and we were able to deposit them with controlled velocity in a prescribed position.

This research aims to develop new physical grounds for printing a broad range of fluids and droplets.

Delivery and spraying of biofluids

Kornev's lab

❑Strategic goal:

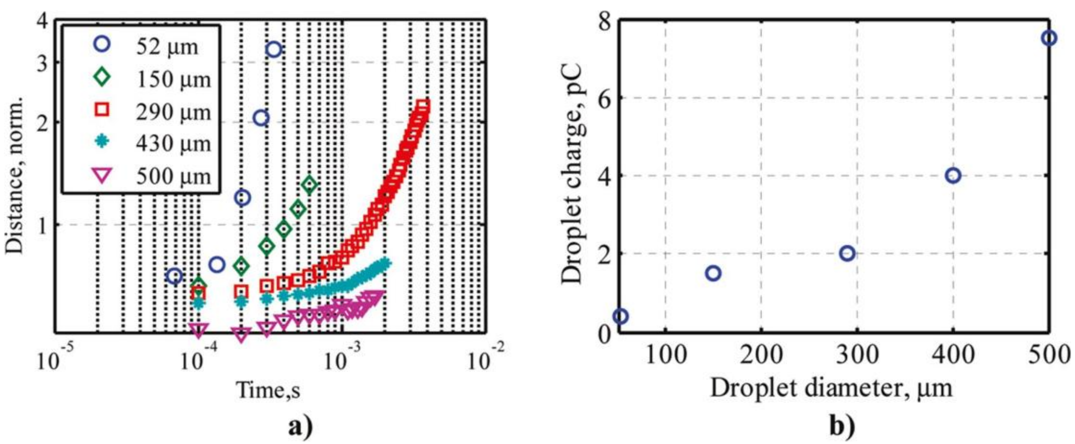
Development of electrogenerators to control drop formation and delivery

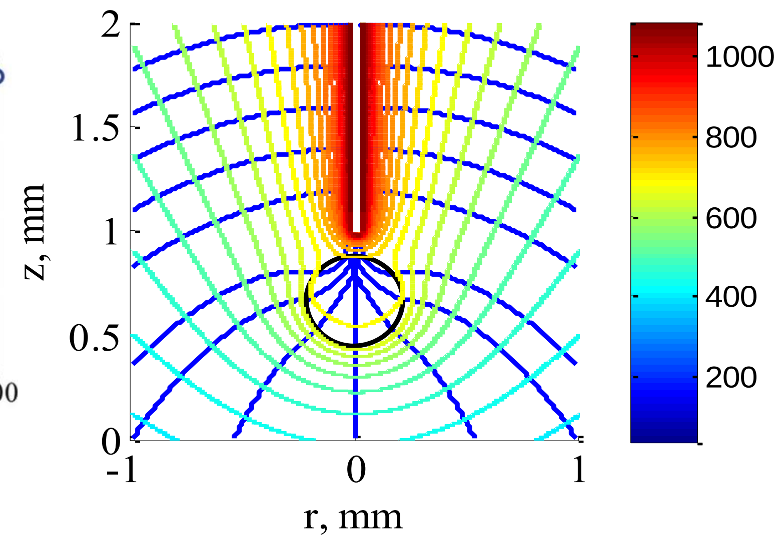
❑Current focus on:

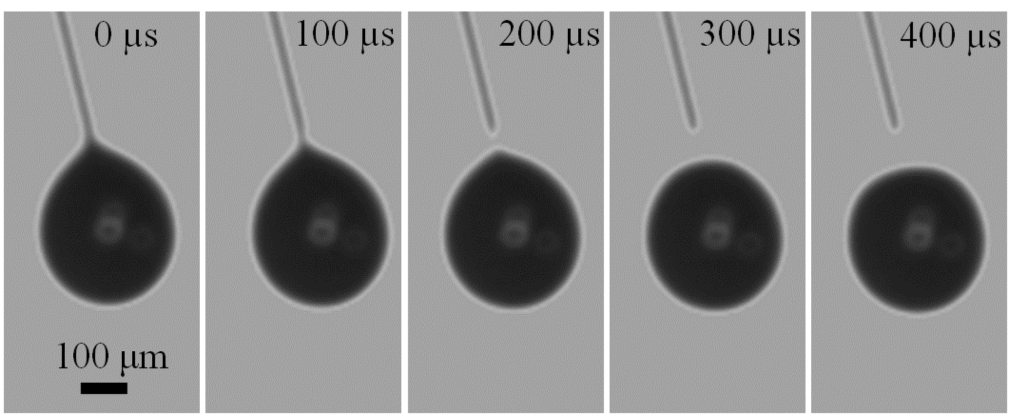
❑Studying dynamics of drop formation

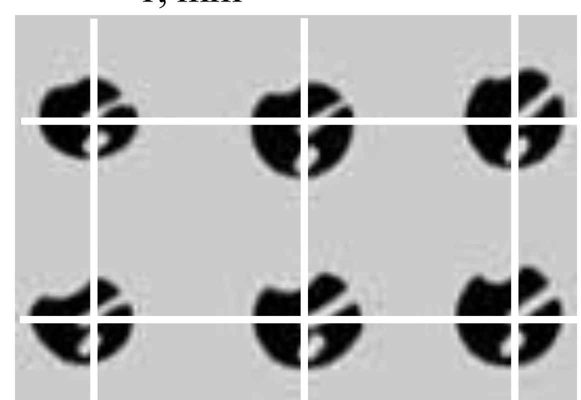
❑Applications:

Printing and spraying of biofluids









Group members: Andrukh

Langmuir, 2011

Interaction of droplets with porous materials

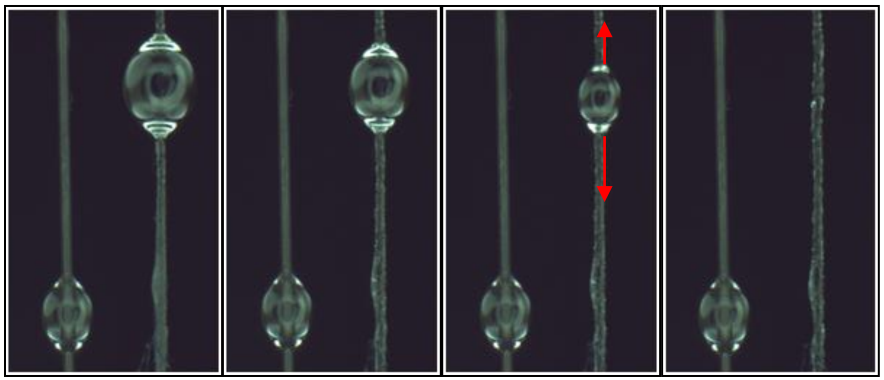
Kornev's lab

❑**Strategic goal:**
Design of porous materials with predictable properties interacting with droplets

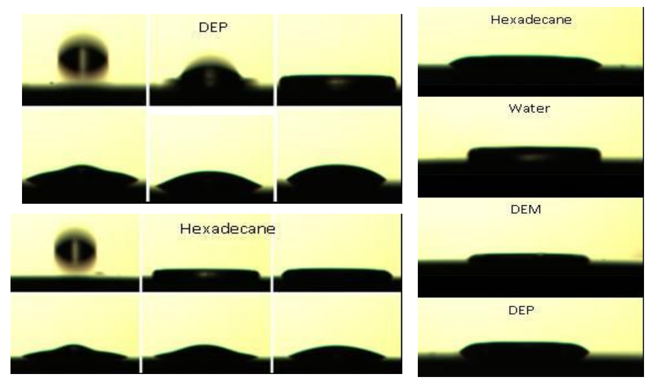
❑**Current focus on:**
❑Studying dynamics of drop penetration

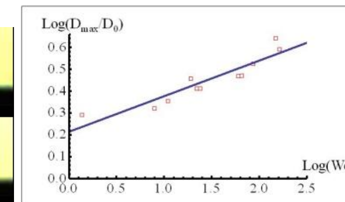
❑**Applications:**
Protective materials & probes

Droplet spreading & evaporation on yarns



Characteristic features of droplet spreading upon impact



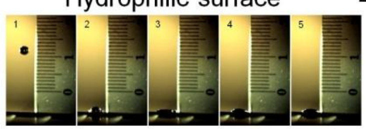


Logarithmic values of normalized Spreading factor obtained experimentally vs Weber number. Blue line is the best fit

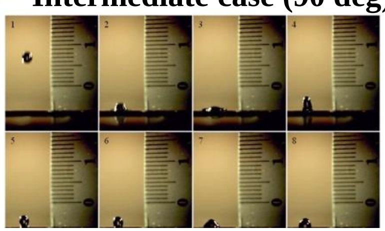
Criterion for drop rebound.

Hydrophobic surface

Hydrophilic surface

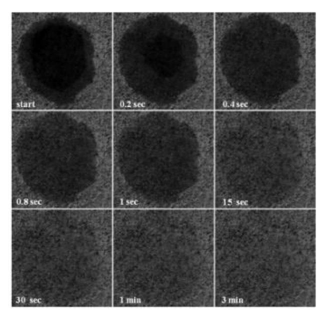


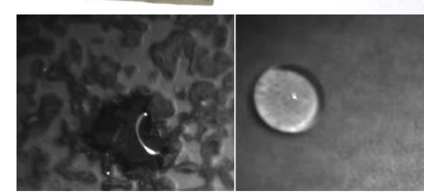
Intermediate case (90 deg)



Different velocities

Characteristic features of droplet spreading upon impact on rough & porous surface





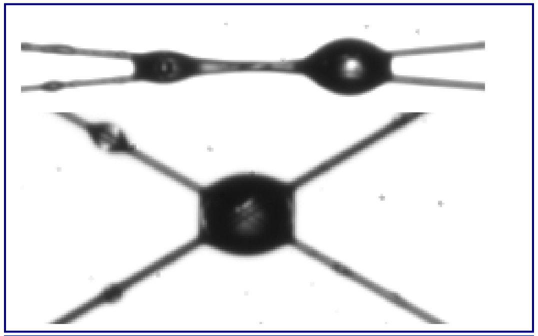
Group members: Andrukh, Monaenkova, Tsai

Fiber-based biofluidics

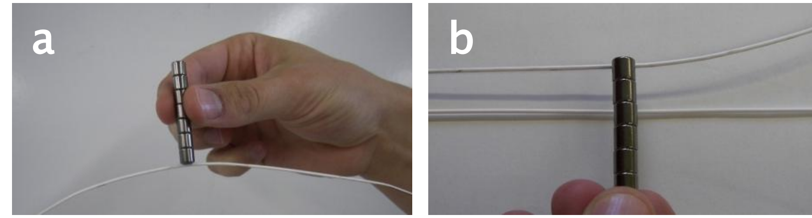
Kornev's lab

Strategic goal:
development of stimuli-responsive fibers and fiber constructs and mechanisms of fiber actuation to design fiber-based micro and nanofluidics and deployable fibrous materials

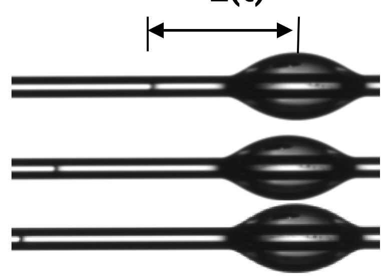
Applications
Micro&nanofluidics for biomedical applications; wet-responsive, temperature responsive, pH-responsive, EM field- and photo-responsive fibers, left handed fibrous materials…

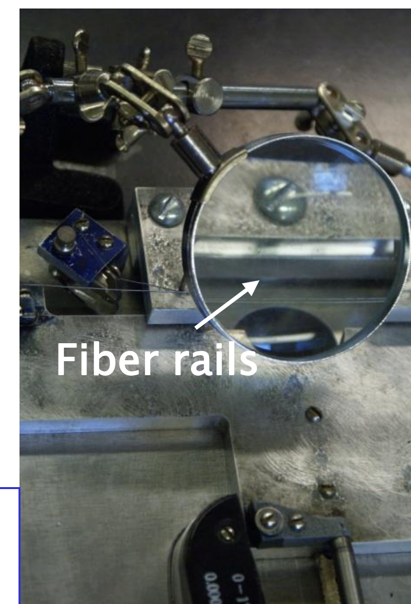


Liquid manipulation by rotating magnetic nanotubes and fibers in the field ⇒ fiber-based micro & nanofluidics, magnetic tweezers, fabrics with tunable pores, deployable fibrous materials



Brett Ellerbrock shows his magnetic polymer fibers: a) fiber is attracted to the magnet; b) if one fiber is magnetic, the spacing between fiber rails can be changed by applying the magnetic field to this fiber.





Microfluidics based on fiber rails: control of ⇒ friction and rate of droplet spreading …

Group members: Andrukh, Monaenkova, Dudley

Collaborators: Brown, Luzinov, Groff, CU; Cebers, Latvian University