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Microscopic Rayleigh Droplet Beams R.B. DOAK, D. STARODUB, U.J. WEIERSTALL, J.C.H. SPENCE, Arizona State University — A periodically triggered Rayleigh Droplet Beam (RDB) delivers a perfectly linear and periodic stream of identical, monoenergetic droplets that are phase-locked to the trigger signal.[1] The droplet diameter and spacing are easily adjusted of choice of nozzle diameter and trigger frequency. Any liquid of low viscosity may be emloyed as the beam fluid. Although the field of nanofluidics is expanding rapidly, little effort has yet been devoted to "external flows" such as RDB's. At ASU we have generated RDB's of water and methanol down to 2 microns in droplet diameter. Nozzle clogging is the sole impediment to smaller droplets. Microscopic Rayleigh droplet beams offer tremendous potential for fundamental physical measurements, fluid dynamics research, and nanofabrication. This talk will describe the apparatus and techniques used at ASU to generate RDB's (surprisingly simple and inexpensive), discuss the triboelectric phenomena that play a role (surprisingly significant), present some initial experimental fluid dynamics measurements, and briefly survey RDB applications. Our particular interest in RDB's is as microscopic transport systems to deliver hydrated, undenatured proteins into vacuum for structure determination via serial diffraction of x-rays or electrons. This may offer the first general method for structure determination of non-crystallizable proteins.

[1]Image at: http://physics.asu.edu/doak. Funded by NSF 0429814.

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