
Stretching of Heated Threads: Glass Microelectrodes¹

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Stretching of heated cylindrical threads with temperature-dependent viscosity occurs in a variety of applications, including the formation of optical fibers and glass microelectrodes. Glass microelectrodes play an essential role in cell electrophysiology. These micropipettes are used to inject electrical currents and dyes into cells and measure membrane potentials when they are inserted through cellular membrane or when a patch clamp of the membrane is formed. They are “pulled” in electrophysiology laboratories around the world on a daily basis using commercially available glass tubes and puller devices that use coil heaters to soften the glass during pulling. The puller’s parameters are set on a trial and error basis. To make this process more systematic, a mathematical fluid model of the glass tube was developed to predict the stretching and breakup of the tube using a vertical puller. In this talk, I will describe the physical problem of interest, the fluid model, numerical results, and more recent work on the development of other models.

¹Joint work with Huaxiong Huang (York University), Jonathan Wylie (City University of Hong Kong), William P. Ireland (University of Prince Edward Island), and Peter Howell (Oxford University).