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The Granular Science Laboratory

Prof. Robert M. Miura

Department of Mathematical Sciences

New Jersey Institute of Technology

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11:30 a.m. – 1:00 p.m.

Mechanical Engineering Center - Room 224

Stretching of Heated Viscous Threads

Glass microelectrode formation is an example of the stretching of a heated viscous thread. Glass microelectrodes are used in electrophysiology laboratories throughout the world. These micropipettes are used to inject electrical currents and dyes into cells, and they can measure membrane potentials when they are inserted through a cellular membrane or when a patch clamp of the membrane is formed. They are "pulled" in electrophysiology laboratories 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, we have investigated the stretching and breakup of the glass tube using a vertical puller. Some of these results will be described.

The stretching of heated viscous threads arises in other industrial applications, e.g., in the pulling of optical fibers. I will describe the associated physical problem, the fluid model, analysis of the model, and numerical results. Also, a description of recent work on the analysis of other models for stretching of viscous threads will be given.

Joint work with Huaxiong Huang (York University), Jonathan Wylie (City University of Hong Kong), and Peter Howell (Oxford University)

Robert M. Miura received his BS and MS in Mechanical Engineering from the University of California at Berkeley and his MA and PhD in Aerospace and Mechanical Sciences from Princeton University. He held postdoctoral positions at the Princeton Plasma Physics Laboratory and the Courant Institute at New York University. He has taught at New York University, Vanderbilt University, and the University of British Columbia, and currently is a Distinguished Professor of Mathematical Sciences and is in the Center for Applied Mathematics and Statistics at NJIT. His main research interests are in biological and physical applied mathematics. The areas in which he is currently conducting research include mathematical neuroscience, e.g., the modeling of cortical spreading depression in the brain, and the stretching of heated viscous fibers, e.g., formation of glass microelectrodes. He is a Fellow of the John Simon Guggenheim Memorial Foundation, the American Association for the Advancement of Science, the Royal Society of Canada, and the Society for Industrial and Applied Mathematics. Currently, he is the Chair of the Board of Trustees for the Mathematical Biosciences Institute funded by the National Science Foundation and Ohio State University. He has served on several editorial boards, and presently is on the editorial boards of the *Canadian Applied Mathematics Quarterly, the SIAM Journal on Applied Mathematics*, the *SIAM Book Series on Mathematical Modeling and Computation, the SIAM Book Editorial Board,* and is Co-Editor-in-Chief of the journal, *Analysis and Applications*. He was the Theme Leader for the Biomedical Theme of MITACS in 1998-2003, and was the Chair of the SIAM Activity Group on the Life Sciences in 2007-2008.

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