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Compressible Viscoelastic Flows Generated by Vibrating Nanoscale Structures in Simple Liquids JOHN SADER, DEBADI CHAKRABORTY, The University of Melbourne, MATTHEW PELTON, University of Maryland, Baltimore County, EDWARD MALACHOSKY, PHILIPPE GUYOT-SIONNEST, University of Chicago, KUAI YU, TODD MAJOR, MARY SAJINI DEVADAS, GREGORY HARTLAND, University of Notre Dame — Recent measurements show that the natural viscoelastic response of simple nominally Newtonian liquids, like water and glycerol, can be interrogated directly using the high frequency (20 GHz) vibration of nanomaterials. The extensional mode vibrations of bipyramidal gold nanoparticles were used, generating a predominantly incompressible shear flow. Here, we study the complementary and general case of compressible viscoelastic nanoscale flows. We show that all available constitutive models for these flows, with the exception of a very recent proposal, do not reproduce the required response at high frequency. We demonstrate the utility of this recent model through measurements of the breathing mode vibrations of single gold nanowires immersed in glycerol, over the 40-70 GHz frequency range.

John Sader
The University of Melbourne

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