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Viscoelastic Flows in Simple Liquids Generated by Vibrating Nanostructures JOHN SADER, The University of Melbourne, MATTHEW PELTON, University of Maryland, Baltimore County, DEBADI CHAKRABORTY, The University of Melbourne, EDWARD MALACHOSKY, PHILIPPE GUYOT-SIONNEST, University of Chicago — Newtonian fluid mechanics, in which the shear stress is proportional to the strain rate, is synonymous with the flow of simple liquids like water. We report the measurement and theoretical verification of non-Newtonian, viscoelastic flow phenomena produced by the high-frequency (>20 GHz) vibration of gold nanoparticles immersed in water-glycerol mixtures. The observed viscoelasticity is not due to molecular confinement, but is a bulk continuum effect arising from the short time scale of vibration. This represents the first direct mechanical measurement of the intrinsic viscoelastic properties of simple bulk liquids, and opens a new paradigm for understanding extremely high frequency fluid mechanics, nanoscale sensing technologies, and biophysical processes.

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