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Viscous flywheel sensing of nanoparticles GEORGIOS KATSIKIS, Massachusetts Institute of Technology MIT, JESSE COLLIS, The University of Melbourne, SCOTT M KNUDSEN, Massachusetts Institute of Technology MIT, VINCENT AGACHE, University Grenoble Alpes, CEA, LETI, JOHN SADER, The University of Melbourne, SCOTT R MANALIS, Massachusetts Institute of Technology MIT — From accelerometers and gyroscopes to microresonators, inertia is often sensed to control motion or measure the physical properties of an analyte. Here, we demonstrate inertial sensing of the physical properties of nanoparticles by local rotation of a microfluidic channel. Through experiments with fluid suspended nanoparticles in hollow microcantilevers and an analytical theory, we show that inertial sensing in our system can directly measure nanoparticle volume. Paradoxically, particle mass only emerges when viscous effects in the fluid become dominant over inertia. We explain this paradox via a viscosity-driven hydrodynamic coupling between the particle and the microfluidic channel, that turns the former into a 'viscous flywheel'. Our modality now enables the simultaneous measurement of nanoparticle volume and mass, using a single measurement.

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