Abstract Submitted
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Correlating Viscoelasticity with Metabolism in Single Cells using Atomic Force Microscopy[1] MATTHEW CAPORIZZO, CHARLES ROCO, CARME COLL-FERRER, Materials Science Engineering, DAVID ECKMANN, Anesthesiology and Critical Care, RUSSELL COMPOSTO, Materials Science Engineering — Variable indentation-rate rheometric analysis by Laplace transform (VIRRAL), is developed to evaluate Dex-Gel drug carriers as biocompatible delivery agents. VIRRAL provides a general platform for the rapid characterization of the health of single cells by viscoelasticity to promote the self-consistent comparison between cells paramount to the development of early diagnosis and treatment of disease. By modelling the frequency dependence of elastic modulus, VIRRAL provides three metrics of cytoplasmic viscoelasticity: low frequency stiffness, high frequency stiffness, and a relaxation time. THP-1 cells are found to exhibit a frequency dependent elastic modulus consistent with the standard linear solid model of viscoelasticity. VIRRAL indicates that dextran-lysozyme drug carriers are biocompatible and deliver concentrated toxic material (rhodamine or silver nanoparticles) to the cytoplasm of THP-1 cells. The signature of cytotoxicity by rhodamine or silver exposure is a frequency independent 2-fold increase in elastic modulus and cytoplasmic viscosity while the cytoskeletal relaxation time remains unchanged independent of cytoplasmic stiffness. This is consistent with the known toxic mechanism of silver nanoparticles, where mitochondrial injury leads to ATP depletion and metabolic stress causes a decrease of mobility within cytoplasm.

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