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Simultaneous Nanomechanical and 3d Optical Microscopy: Cellular Distortions and Structural Dynamics¹

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Combined SPM and Optical systems are increasingly used to study biological structures, including living cells. Here, an AFM is employed to expose cells to foreign bodies and biochemicals, and to measure the resulting attractive and repulsive forces exerted by the cell. 3d optical fluorescence measurements are simultaneously performed revealing distortions and/or restructuring of the cell, membrane, actin cytoskeleton, etc. The work focuses primarily on MH-S cells (mouse lung macrophages) transfected with GAP-43 GFP to identify cell membranes and/or mCherry Actin to identify cytoskeleton dynamics. During standard AFM, optical-cross sections reveal drastic cell distortions up to 50 percent. The viscoelastic response of the cells to nanoNewton induced forces by Silica and Polystyrene beads is also quantified via Structural Recovery After Probing (S_{Tr}AP), which monitors the rate of cellular recovery following nanoindentation.

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