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AFM imaging of mechanical properties of cell surface for earlier and more reliable detection of cervical cancer

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Abstract

Atomic force microscopy (AFM) allow imaging the cell surface with substantially higher resolution than optical and even electron microscopy. In addition, new "nanomechanical" modes recently developed provide a unique "mechanical" mapping of various physical mechanical properties of cell (elastic modulus, adhesion, and energy dissipation). The analysis of these maps brings about 120 new parameters (roughness, fractality, screwness, etc.) to characterize physical properties of cells. Our analysis done on human cervical epithelial cells shows that these parameters can provide with a much more accurate detection of cancer when compared to the currently used cervical cancer prescreening tests (Pap smear/liquid cytology). For example, we demonstrate that even a single parameter, fractal dimensionality of adhesion maps, can be used to distinguish virtually unambiguously cancerous/precancerous (immortal) cells and normal cells. If such sensitivity to cancer/precancer is extrapolated to the current practice of prescreening cervical cancer, it could make unnecessary about 3.1 million biopsies (typically done together with DNA test) done in only the United States per year.

Biography

Dr. Igor Sokolov received his B.S. and M.S. in physics from St. Petersburg State University, Russia in 1984, and earned his Ph.D. from D.I. Mendeleev Institute for Metrology, Russia in 1991. He is a professor and the Bernard M. Gordon Senior Faculty Fellow in the departments of Mechanical and Biomedical Engineering of Tufts University. He has 135 refereed publications, more than 20 patents issued and pending, and serves as an editorial board member in a number of journals. Igor's current research focuses on nanomechanics of cells and biomolecules, nanophotonics, and the early detection of cancer.

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