Statement of the Problem: The pericellular brush/coat (PB) is a brush like layer that covers cell body of all eukaryotic and the majority of prokaryotic cells. The PB layer plays an important role in physics of cells. The changes in the PB layer have been implicated in the pathogenesis of many diseases, including cardiovascular disorders, inflammation, and cancer. Nevertheless, the PB layer is rather poorly studied. The existing biochemical methods to study the pericellular coat are specific to a particular type of molecules (content of which is frequently unknown) and lack of spatial resolution.

Methodology & Theoretical Orientation: We describe two novel methods based on the use of atomic force microscopy (AFM) to study the PB layer. One method is based on the analysis of force curves recorded during cell indentation. The PB layer can be studied by processing these curves with so called brush model. One can obtain physical characteristics of the PB layer, the grafting density and the brush size. The second method, ringing mode is based on the analysis of the ringing signal recorded with the AFM sub resonance tapping mode. One of the channels recorded in the ringing mode, the length of the grafted-to-the-cell-surface molecules, the size of the PB layer.

Findings: The first method can work with viable cells. It detects all molecules present in the PB layer without any presumptions of the biochemical methods. However, the spatial resolution is restricted in this method by the size of the appropriate AFM probe, which would be of the order of a micron. The problem of spatial resolution is solved in the second method, ringing mode. Although this method can be applied to both viable and fixed cells, it works the best on fixed cells dried in air. The lateral resolution can be as small as a few nanometers.

Figure 1: An example of the distribution of molecules within the pericellular brush (PB) layer, which surrounds human melanoma cancer cells.
Recent Publications


Biography

Igor Sokolov is an expert in atomic force microscopy in studying cells and biological tissues. Being initially trained as a Physicist, he received Postdoctoral training in Microbiology. He is the recipient of the E L Ginzton International Fellowship Award from Stanford University for his work on atomic force microscopy, he received Graham Research Award (Clarkson University), Simon Greenberg Foundation Scholarship for the study of aging skin, etc., in 2000 he joined Clarkson University, where he achieved the title of Full Professor and served as Director of the Nano-engineering and Biotechnology Laboratories Center. He has 150+ refereed publications, including such journals as Nature, Nature Nanotechnology, Advanced Materials, etc., He holds 20+ patents. His current research focuses on nano-mechanics of soft material, molecules and cells; atomic force microscopy; nanophotonics and the studies towards understanding of nature of cancer, early detection of cancer based on altered biophysical properties; self-assembly.