High Resolution Surface Plasmon Resonance Imaging of Focal Adhesions in Single Cells

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***Abstract*—Surface plasmon resonance imaging (SPRI) is a powerful label-free technique that has been only recently applied to the field of cell biology.**

High resolution label-free imaging of subcellular features can be performed using a high numerical aperture objective lens with a digital light projector to precisely position incident angle excitation. The SPRI signal is a result of the mass of material within the evanescent field, the refractive index of the material, and the distance between the material and the substrate.

Cellular components near the sensor surface such as the cell membrane, focal adhesions, cell nucleus, and extracellular material deposited at cell periphery are visualized in the SPRI image. The optical contrast in the SPR images is sufficient to define the edge of the cell with relatively high signal-to-noise corresponding to the cell membrane.

Within this cell membrane region, SPR images show punctate regions of high reflectivity that are putatively the cellular focal adhesions. Focal adhesions are known to be regions of high protein density that reside at the cell-substratum interface. Comparing SPR analyzed images with fluorescent antibody stain for vinculin in rat aortic smooth muscle cells reveals a similar distribution of focal adhesion size and normalized intensity. Subsequently, comparing SPR images for several cell types reveals a distinct difference in focal adhesion intensity levels corresponding to a difference in protein density. In general, a positive correlation between focal adhesion size and intensity level is revealed by SPR imaging.

Also, visualized around the cell edge is extracellular deposited material that corresponds to an approximate monolayer coating that extends beyond the cell, up to 40 μm around the cell periphery, indicating the ability to visualize cell secreted modification of the substrate for specific cell types.