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How Optical/Biophysical Complements Biochemical Characterizations in Cellular Mechanobiology

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In recent years, the critical roles of physical & mechanical cell-cell interactions and cell-ECM (extra-cellular matrix) interactions in the physiological functions and the pathological status at the cellular level have received increasing attentions [1, 2]. Specifically, the studies of the cellular response to external physical, mechanical, and chemical stimuli in the context of Epithelial-Mesenchymal Transition (EMT) and the associated reversed process of Mesenchymal-Epithelial Transition (MET), which play an essential role in developmental biology, and in cancer metastasis as well as in stem cell differentiation [2-4], have shed light on the molecular pathways and/or mechanisms of these processes with important biomedical implications.

In this talk, I will start with a brief introduction to optical microrheology [5] and cellular mechanobiology [1 2], followed by a few selected examples to highlight how the measurements of cellular viscoelasticity via optical microrheology, in conjunction with those of cellular morphology, areas of focal adhesion, cytoskeleton structures, and cell migration, via optical microscopy complement the associated biochemical characterizations to provide a set of metrics to characterize the dynamics of these processes (namely, EMT, MET, and Stem differentiations) in a multi-dimensional space. Besides, in contrast to the conventional biochemical approaches, the optical/biophysical methods highlighted in this talk enable us to measure the physical and mechanical properties at the single cell level, and often with subcellular spatial resolution, and tens of millisecond temporal resolution.

References

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