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Application of mesoscopic light transport theory to ultra-early detection of cancer in a single biological cell PRABHAKAR PRADHAN, HARIHARAN SUBRAMANIAN, YANG LIU, YOUNG KIM, HEMANT ROY, VADIM BACKMAN, Northwestern University, Evanston, IL 60208 — We report application of mesoscopic light transport theory to ultra-early detection of carcinogenesis in a single biological cell. In early stages, the progression of carcinogenesis is accompanied by nanoscale morphological changes in the internal structure of a biological cell. Such changes result in nanoscale alterations of the refractive index distribution in cells, which modulate the nanoscale light transport properties of a cell. Understanding the mesoscopic/nanoscopic light transport properties of cells is therefore important for detecting the progression of carcinogenesis in a cell or tissue. We have developed a new technique – partial wave spectroscopy (PWS) – to measure changes in nanoscale light transport properties associated with the nanometer scale refractive index alterations in a cell. We quantify the cell's refractive index fluctuations using mesoscopic light transport theory. Our results using rat/human cells demonstrate that the PWS technique is able to detect ultra-early refractive index fluctuation changes at the nanoscale associated with the progression of carcinogenesis in these cells. This method can be used as a potential biomarker for ultra-early detection of cancer.

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