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Raman Spectroscopy: An Emerging Tool for Clinical Diagnostics

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Biomedical applications of lasers and laser spectroscopy are changing the face of medicine as it is currently practiced. Spectroscopy is a promising means of extracting biochemical and morphological information from tissue that is relevant to disease progression and diagnosis. In particular, Raman spectroscopy is a powerful tool for non-invasive and real time diagnosis due to its exquisite molecular specificity and lack of sample preparation requirements. Raman spectroscopy, which measures the molecular vibrations of a sample, is currently being used to study atherosclerosis, measure blood analytes, and detect dysplasia and cancer in various tissues including the breast, cervix, prostate, and skin. In this talk, we present our results on quantitative biological spectroscopy for non-invasive blood analyte detection. Our work in this area is primarily motivated by the necessity for accurate and frequent measurement of blood glucose levels, which is most commonly achieved by withdrawal of blood. Given the inconvenience and invasiveness of this procedure, a non-invasive method would greatly benefit the increasing number of diabetics. Our laboratory has successfully demonstrated the ability to measure glucose, urea and other blood analytes in serum, whole blood and individual human volunteers. In addition, we present our results for turbidity correction and suppression of tissue autofluorescence in biological Raman spectroscopy. We show that correction for these non-analyte specific variances provides a clinically accurate and robust calibration algorithm that can be used for prospective prediction in human population. Finally, we discuss our plans for miniaturization of the device for point of care and commercial applications.