
Raman Sensing of Cell Differentiation

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Stem-cell based therapies, and personalized medicine necessitates non-disruptive and efficient quality control of cell cultures. Raman microscopy, as label-free methodology, has the potential to become the technique of choice in that respect. Classical Raman microscopy however falls short in speed required for high-throughput applications. Here we combined the unique advantages of Raman spectroscopy with a compressed sensing scheme to address these limitations. We integrated advanced high-resolution wide-field microscopy with confocal capabilities that incorporate a rapid compressed-sensing Raman detection scheme. Compressed sensing is realized using volume-grating spectral separation and refocusing, digital micromirror device (DMD) compression, and single-photon counting avalanche photodiode detection. Together, these components realize a digitally controlled spectral-fingerprint imaging modality. Preliminary results confirmed the feasibility of our approach. The spectrometer was set to a spectral resolution of approximately 0.642 nm, sufficient for resolving individual Raman lines. The lateral optical resolution is about 400 nm, as determined by the numerical aperture of 10x imaging lens. The total detection throughput is approximately 0.05. We demonstrate Raman-based identification of several known compounds, including Guanidine Hydrochloride, components of Paracetamol powder, and heavy metal air-pollution composites. We were able to distinguish two standard cell lines by their Raman spectra.