Spontaneous Brillouin scattering is an inelastic scattering process arising from inherent thermal density fluctuations, or acoustic phonons, propagating in a medium. The recent development of high throughput efficiency Virtually Imaged Phased Array (VIPA) etalons and high sensitivity CCD cameras has dramatically reduced the data acquisition time, in turn enabling the extension of Brillouin spectroscopy from a point sampling technique to an imaging modality. Hitherto Brillouin microscopy has shown great capabilities to non-invasively assess the biomechanics in the volume of biological tissues, such as the lens cornea [1] and atherosclerotic plaques [2].

Figure 1. Cell cross sections before (a) and after (b) exposing the cell to latrunculin-A. A Brillouin image of the same cell taken at higher sampling resolution (c), and the associated phase-contrast image (d). A bar-plot shows the change (mean±SEM) in the longitudinal modulus of the cytoplasm and nucleoli in response to latrunculin-A (*p<0.001) (e).

In this work, Brillouin microscopy was validated in a controlled setting to investigate the subcellular biomechanical properties in healthy primary cells in vitro [3]. Results indicate that separate cellular compartments such as the cytoplasm, nuclear membrane, and nucleoli have markedly different mechanical properties. In addition, cytoplasmic stiffness was significantly reduced after administration of the drug latrunculin-A. In contrast, nucleoli did not exhibit significant changes in stiffness in response to latrunculin-A. These observations are consistent with our hypotheses because latrunculin-A acts by preventing polymerisation of the actin cytoskeleton. As such, these results validate Brillouin microscopy as a technique to investigate the cellular and subcellular mechanical properties of a volume of cells in vitro, and their changes over time or in response to external stimuli.