VISUALIZING CELLULAR MICROSTRUCTURE BY LIGHT SCATTERING MICROSCOPY

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ABSTRACT
Elastic light scattering with angular or spectral resolution can support non-invasive detection of tissue changes, e.g. upon diagnosis or treatment of cancer. In particular, the angular resolution of Mie scattering provides valuable information about the microstructure of cells and their organelles (e.g. nuclear diameter), tissue architecture as well as changes related to necrosis or apoptosis.

In Fig. 1 a microscope setup is presented permitting scattering measurements of single cells, cell clusters and 3-dimensional cell spheroids with a resolution of ±1°. Angular resolution is achieved by focusing a 470 nm laser diode into the aperture of the microscope objective lens (e.g. 40x / 1.30 oil immersion) after deflection by an adjustable mirror. Thus, the samples are illuminated by a parallel beam under variable angles. Scattered light is collected by the same objective lens and further focused by a Bertrand lens generating an image of the aperture plane. Within this image a central region of ±1° is selected by a tiny aperture, so that backscattering can be measured in an angular range between slightly above 180° and 230°.

Preliminary results indicate that elastic light scattering can be related to cell morphology in monolayers or spheroids. An example is given in Fig. 2 for 3T3 human fibroblasts prior and after apoptosis. In the latter case, increased intensity and oscillations of Mie scattering (Fig.) reflect cell shrinking and formation of small spherical structures. Scattering parameters may, therefore, give complementary information on cell metabolism and cell death in addition to autofluorescence and Raman scattering.

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