Fast, super-resolution live-cell imaging by rotating coherent scattering (ROCS) microscopy

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Thermal and active cellular forces drive biological structures. The resulting movements become faster the smaller the biological structures are because of less friction and steric hindrance. This is an important aspect for super-resolution microscopy, since unfortunately, the resolution of smaller structures requires more photons and hence more time. Therefore, novel concepts enabling smart trade-offs between temporal and spatial resolution have to be developed.
Here, we present a variant of an oblique illumination super-resolution microscopy scheme [1, 2] based on rotating coherent scattering (ROCS). The technique generates thousands of high contrast images without post-processing at frame rates of more than 100 Hertz and does not require labeling. The technique scans the sample over all azimuthal illumination angles within a single camera exposure time and allows for various illumination and detection modes such as bright-field, dark-field or total internal reflection (TIR). Thus, structures as small as 150 nm become separable through local destructive interferences. The technique is applied to living mouse macrophages and compared to simultaneously recorded TIRF images revealing unexpected dynamic biological processes.

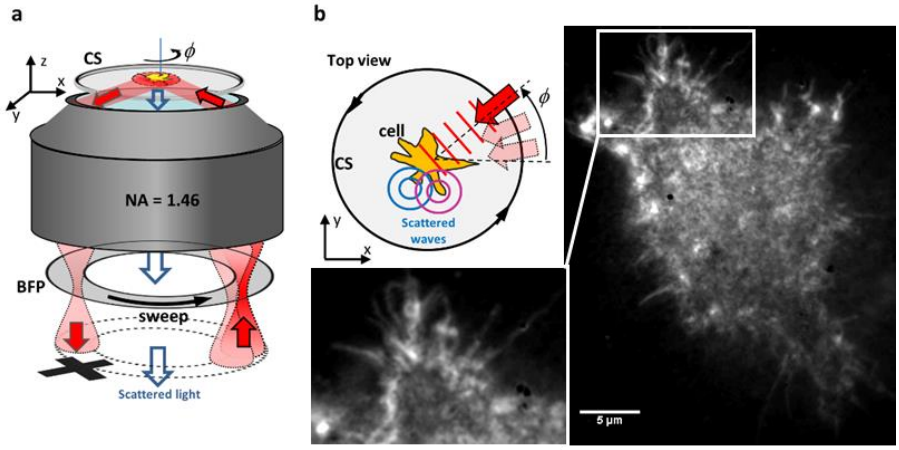

Figure: *(Left)* Illustration of the rotating illumination scheme used in ROCS microscopy. *(Right)* DF-ROCS image of a J774 macrophage.

[1] Jünger F, Olshausen P, Rohrbach A., Fast, label-free super-resolution live-cell imaging using rotating coherent scattering (ROCS) microscopy (2016) Sci Rep-uk, Band: 6, Seite: 30393
[2] Olshausen P, Rohrbach A., Coherent total internal reflection dark-field microscopy: label-free imaging beyond the diffraction limit (2013) Opt Lett, Band: 38, Nummer: 20, Seiten: 4066 – 4069