Quantum optics meets microscopy – An ultra-sensitive resonator microscope for nano- and life sciences

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Abstract

Isolated nanoscale systems provide only weak interaction with light due to their small size and therefore often escape direct observation in conventional light microscopy. This limits insights into individual nanosystems and slows down research in the fields of nanotechnology, material science, drug design, and pharmaceutical diagnostics.

To overcome these limitations, our group continuously developed optical micro-resonators, a technology pioneered in quantum optics [1]. In these resonators, light passes a sample up to 100.000 times and thereby enhances weak absorption signals tremendously. By means of micro-cavities with a small mode waist a scanning microscopy approach, i.e. ultra-sensitive spatially resolved absorption measurements near the diffraction limit, can be performed [2]. By optimizing the mechanical stability and by developing integrated electronics, extinction cross section of 1 nm2 can be imaged in real time.

The potential of this new type of microscopes is illustrated by imaging of individual carbon nanotubes [3], 2D-materials [4,5], and label free imaging of ultrathin biological sections [6].

References

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