Left:
CNBP Researcher
Dr. Philipp Reineck

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Dr. Yiqing Lu

Case Study

Brighter Signals from Nanoparticles

PHOTOSTABLE NANO-PROBES

Dr. Philipp Reineck

Fluorescent nano-probes allow us to label specific parts of a biological cell. In principle, this allows us to observe biological processes on the scale of single cells in real time such as the active transport of cell components along a microtubule, which is one type of intracellular 'highway'.

A great challenge is that most fluorescent probes used today stop to fluoresce rapidly when imaged—an effect known as photo-bleaching.

We develop fluorescent diamond nano-probes that are perfectly photostable. Our probes are not only photostable, but can also sense temperature and magnetic fields.

We have recently discovered a new fundamental phenomenon: an increase of diamond fluorescence caused by a magnetic field. In our interdisciplinary team within the CNBP we also develop diamond probes that are sensitive to important cellular signalling molecules. This way we will be able to track movement and detect cellular signals simultaneously.

We continue to push the boundaries of fundamental science to develop brighter and smaller diamond probes, which has uncovered a new class of very bright fluorescent nanodiamond.

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NANO LASER CRYSTALS

Dr. Yiqing Lu

The use of nanoparticles in microscopy imaging holds tremendous potential for researchers, aiming to examine dynamic biomolecular processes in ultra-fine detail in the body.

Issues however, include the need for high illumination power requirements that can damage biological samples as well as unwanted background noise in the biological sample that limits the contrast of what can be seen.

Our research breakthrough has been to develop a new generation of bright luminescent nanocrystal—one in which the chemical element thulium, extensively used in lasers, has been added at high concentrations.

This new particle exhibits a unique "photon avalanche" effect, whereby emission photons are generated at higher efficiency, substantially amplifying brightness using low-power infrared illumination light. It has allowed us to achieve images with a super resolution of 28nm, together with multiple other benefits—the suppression of unwanted interference as well as reduced complexity and cost, across the total imaging system.

Our work illustrates that tiny laser nanocrystals offer substantial potential as a new generation of luminescent probes for optical microscopy at the nanoscale level.

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