idw - Informationsdienst Wissenschaft
Nachrichten, Termine, Experten

Press release

Max-Planck-Institut für Polymerforschung
Dr. Christian Schneider
02/25/2025
http://idw-online.de/en/news847979

Scientific Publications
Biology, Chemistry, Physics / astronomy
transregional, national

Prolonged super-microscopy: Nanographenes allow longer observation times

The 2014 Nobel Prize in Chemistry was awarded for the development of super-resolved fluorescence microscopy, including STED (Stimulated Emission Depletion) microscopy. This method can be used to observe processes, e.g. in cells, at particularly high resolution. Researchers at the Max Planck Institute have now enhanced this method by replacing traditional fluorophores with nanographenes, enabling the observation of longer-duration processes, overcoming a limitation of STED microscopy to date.

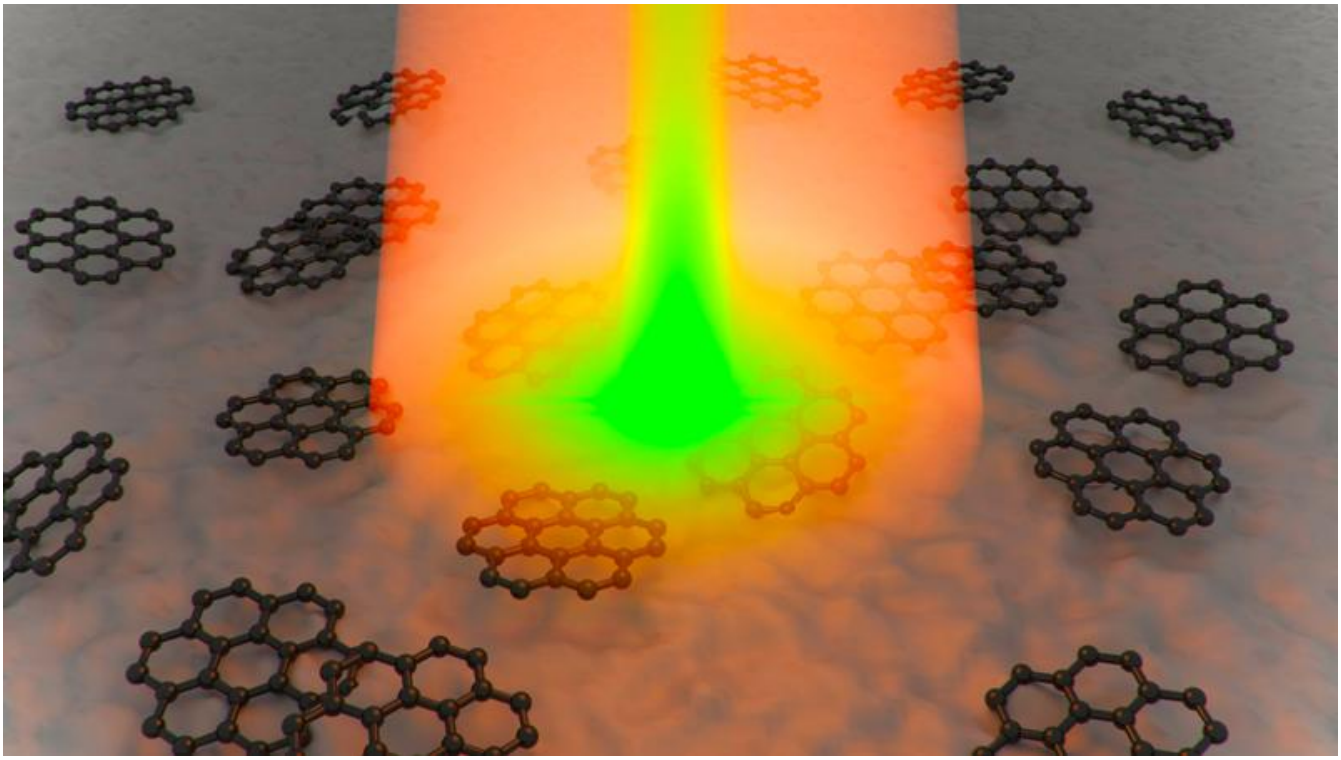
Conventional microscopes are limited in their resolution of about 200 nm, as described by physicist Ernst Abbe in the 19th century. However, interesting processes occur at a length scale below this limit, particularly in biological cells. STED microscopy overcomes this barrier, achieving resolution up to 10 times better than conventional methods
STED microscopy uses small fluorescent particles - fluorophores - in the sample that glow (fluorescence) with the help of an excitation laser. A second laser beam with a donut-shaped cross-section can deactivate the fluorescence in a ring-shaped area, leaving only a small central spot (smaller than 200 nm) still glowing. Scanning this beam combination across the sample creates a high-resolution image.
The main limitation of traditional STED microscopy has been the fading of fluorophores under prolonged illumination. This is particularly problematic for observing long-duration processes that require repeated scanning. Researchers led by Xiaomin Liu at the MPI for Polymer Research, in collaboration with Akimitsu Narita and Ryota Kabe from the Okinawa Institute of Science and Technology, have addressed this issue by using nanometer-sized nanographene particles. For nanographenes, the fluorescence fading process can be reversed directly in the sample. The illumination of the nanographene with the doughnut-shaped beam is used for this purpose: This illumination, so to speak, restores the ability of the nanographene to glow.
This new method, presented in the renowned journal Nature Communications, opens up new possibilities for studying previously unobservable processes using super-resolution microscopy. The ability to reactivate nanographenes with inherently high photon numbers makes them ideal for long-time microscopy methods, potentially expanding their applications in biology and materials science.

contact for scientific information:

Dr. Xiaomin Liu
liuxiaomin@mpip-mainz.mpg.de

Original publication:

Yang, Q., Failla, A.V., Turunen, P. et al. Reactivatable stimulated emission depletion microscopy using fluorescence-recoverable nanographene. Nat Commun 16, 1341 (2025). https://doi.org/10.1038/s41467-025-56401-z



Researchers at the Max Planck Institute for Polymer Research have refined the high-resolution method of STED microscopy by using nanographenes. This makes longer observation times possible.