Seeing cells in a new light

Illuminating the tiniest details of living cells just got a major boost: Scientists at the Max Planck Institute for Medical Research have developed new markers that glow in the far-red range and are activated by light. They are stable, easy to control, and compatible with several super-resolution microscopy techniques, as outlined in a paper published in the journal Chem.

So-called photoactivatable dyes, i.e. dyes activated by light, help scientists to see tiny structures, molecules, or processes inside cells. They can be irreversibly switched on by mild ultraviolet or visible light and can be precisely controlled.

Challenges in imaging living cells

In order to study living cells, dyes must be able to easily penetrate the cells and function under normal growth conditions. Previous photoactivatable dyes for living cells were often unstable or could not be reliably activated. This could affect their labelling efficiency, image uniformity, and the duration of imaging experiments. In addition, these older methods often only work in preserved cells, not in living ones.

Spectrum of PaX dyes expanded

The new far-red markers complete the family of PaX dyes (short for "photoactivatable xanthones") that scientists from the Department of Optical Nanoscopy at the Max Planck Institute for Medical Research previously developed. PaX dyes can be activated without appending bulky protective groups reactive to light to the dye – so called “caging”, a traditional approach – and quickly convert into a single, bright fluorescent product without forming any reactive or toxic by-products. Until now, PaX dyes could only produce blue to orange light. Robust red and far-red versions remained elusive, even though they are most helpful for imaging in living cells.

Successfully used in fluorescence nanoscopy

The new far-red additions to the PaX family are compatible with a wide range of conventional and super-resolution fluorescence microscopy techniques. The research team has already successfully validated them in advanced nanoscopy methods including PALM, STED, and MINFLUX procedures.

The new far-red markers can be combined with other PaX dyes, or any commonly used fluorescent labels. This enables multicolor imaging, allowing scientists to observe multiple cell structures simultaneously. In the future, the dyes could help track single molecules with light microscopes and study the interactions of proteins in living cells with molecular-level precision.

Press release

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Further information

- Max Planck Institute for medical research