

Application of quantum dots in plant cell biology

Müller F^{1,2}, Rutten T¹, Claus B¹ & Melzer M¹

¹Institute of Plant Genetics and Crop Plant Research, Corrensstr. 3, 06466 Gatersleben, Germany

²University of Leipzig, Faculty of Physics and Geosciences, Linnéstr. 5, 04103 Leipzig, Germany

E-mail: mueller@ipk-gatersleben.de

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The rapid progress in the field of fluorescence microscopy within the last decades has been accompanied by the development of a wide range of innovative cell biological methods. For example, the introduction of native fluorescence molecules and newly designed fluorophores enabled fresh approaches to localization studies and monitoring dynamic cellular processes. Nevertheless there are still problems remaining to be solved, like photobleaching, overlapping emission spectra and unwanted autofluorescence signals, the latter being particularly problematic in plant tissues.

The idea to create more stable fluorescent molecules with a sufficient range of excitation wavelengths and improved emission spectra resulted in the development of quantum dots (QDs). These inorganic semiconductors are spherical crystals of 10-35 nm in diameter. The specific optical properties of the QD include a wide range of excitation wavelengths. Irrespective of their emission spectrum, all QDs show overlapping absorption peaks in the blue light. Consequently, multiple QDs with different emission spectra can be excited by a single wavelength. This, combined with the remarkably narrow emission spectra of QDs, allows a far more accurate separation of different fluorescence signals.

So far QDs have been used mainly in animal systems. Our goal is to establish their application in plant research. For this purpose immunolabeling experiments were carried out on fixed material of *Arabidopsis thaliana* and *Nicotiana tabacum*. The usefulness of QDs for fluorescence *in situ* hybridization experiments (FISH) was tested on squashed *Allium* root tips. We compared the properties of QD 565 and QD 655 with those of Alexa 488. All investigations were performed on the Zeiss confocal LSM Meta 510 to achieve optimal signal analysis. Our studies showed a significant stronger signal for QDs compared to Alexa 488. In photobleaching experiments QDs still yielded strong fluorescence signals at times when Alexa 488 could no longer be detected. These results proof that the fluorescence signal of QDs is extremely stable and shows high emission characteristics even after intense laser treatment.

These observations indicate that QDs may be advantageous for all fluorescence techniques since they are stable and require low laser intensities. This yields significant reduced tissue damaging and enables therefore longer observation times. In particular multi fluorescence labeling, FISH, FRET and signal detection after high scan intensities like time laps or z-stacks should benefit.

References:

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