Integrated Nano-Scale Imaging for Investigating Applications and Implications of Nanomaterials in the Living Cell

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Purpose

Develop 3D super-resolution fluorescence imaging and x-ray tomography techniques for investigating the cellular interactions and fate of individual nanoparticles in the intact cell with nanometer resolution.

Use these approaches to study the relationships between nanomaterial properties and their cellular fate and response.

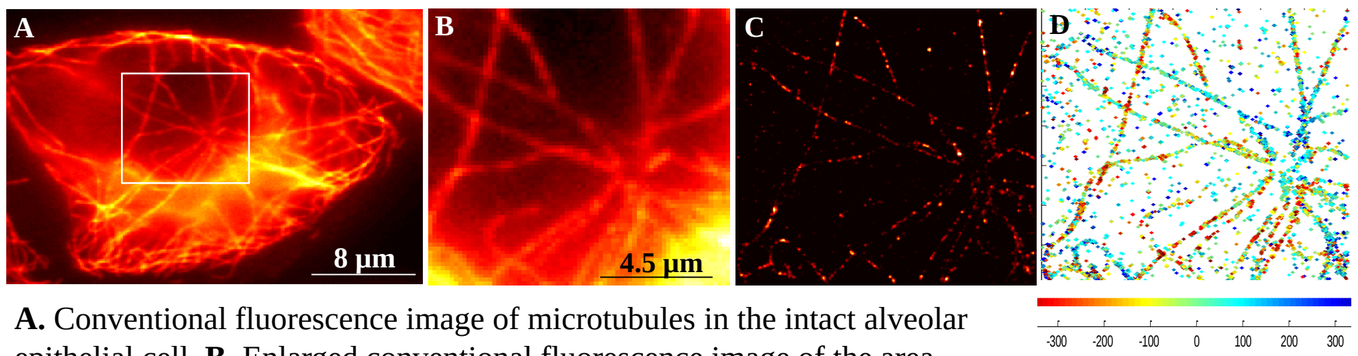
Expected Outcomes

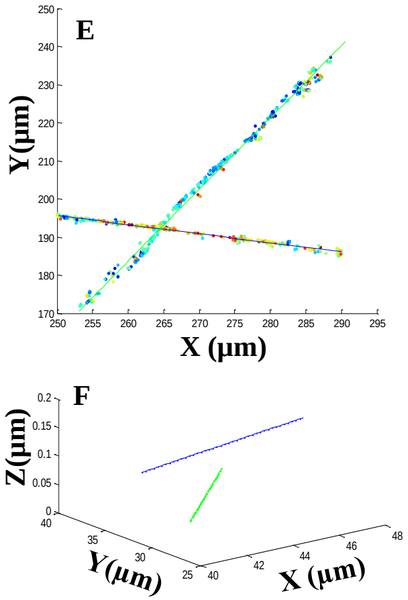
Identify the impact that distinct properties of engineered nanoparticles impose on the living cell and ultimately on human health.

Gain new understanding of cellular mechanisms that underlie nanoparticle toxicity or biocompatibility to enable the design of safer nanomaterials and accelerate their application in nanotechnology.

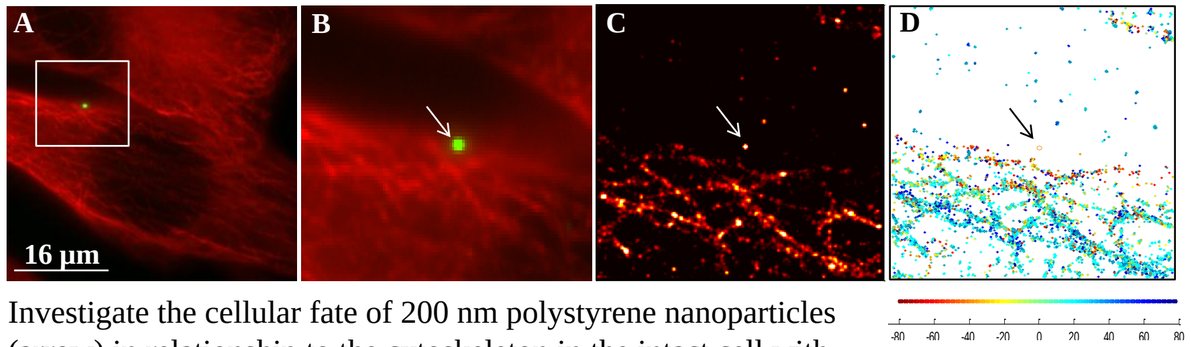
Progress

Achieved 3D super-resolution fluorescence images of sub-cellular structures in the intact cell with 20-nm resolution using Stochastic Optical Reconstruction Microscopy (STORM)





A. Conventional fluorescence image of microtubules in the intact alveolar epithelial cell. **B.** Enlarged conventional fluorescence image of the area marked by the square in A. **C.** Super resolution fluorescence image of the area in B. **D.** Color-coded 3D representation of the image in D. **E.** and **F.** First steps toward spatial representation of the 3D image focusing on two microfilaments.



Investigate the cellular fate of 200 nm polystyrene nanoparticles (arrow) in relationship to the cytoskeleton in the intact cell with nanometer resolution in 3D.

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