Intracellular trafficking of nanoparticles determined by spatiotemporal fluorescence tracking

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Intracellular distribution of nanoparticles and their interactions with cellular organelles during the course of intracellular trafficking has been emphasized as key information in the field of nano-biotechnology. We investigate intracellular fate of silica nanoparticles at a single nanoparticle level using a complementary imaging analysis which combines transmission electron microscopy and super-resolution confocal laser scanning microscopy with fluorescence correlation spectroscopy. The endocytic pathway internalizes the nanoparticle from the plasma membrane to a set of endosomes over time until degraded by the cellular autolysosomes in the perinuclear region. Spatiotemporally tracing the intracellular behavior of an individual nanoparticle reveals that the nanoparticle is spontaneously released from the endosome and transiently stimulates autophagy. Moreover, the size of autophagosomes increases over time while cell viability is maintained. We show non-cytotoxic biological degradation of the silica nanoparticle, resulting from chemical inertness and stimulated autophagic clearance.