Quantitative Measurement of Nano/Micro Particle Endocytosis with Cell Mass Spectrometry

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摘要

Nano/microparticles have been actively pursued as an efficient way for drug delivery. Therefore, quantitative measurement of cellular uptake of nano/micro particles is of great importance in understanding the mechanisms of cell endocytosis and exocytosis process. One of the motivations for such measurement is to provide a rapid means for quantifying nano/micro particle uptake into mammalian cells. The conventional ways involve both inductively coupled plasma atomic emission spectroscopy (ICP-AES) and inductively coupled plasma mass spectrometry (ICP-MS), which are accurate but are limited to elemental species, such as gold nanoparticles (NPs). Our technology provides a novel approach to investigate the amounts of nano/micro particle uptake into mammalian cells. We developed cell mass spectrometry (CMS) to directly measure the masses of cells in gas phase. We found the quantity of gold NP uptake into cells measured by CMS was the same as that by ICP-MS. CMS can determine the number of NP uptake on each individual cell whereas ICP-MS only get a mean of all cells. In addition, it can be used to measure not only the cellular uptake of metal nanoparticles but also the non-metal nano/micro particles. This strategy may help to monitor drug delivery by nanocarriers. For example, CMS can be a valuable tool to measure the quantity of liposome uptake into cancer cells. In the future, we also plan to apply this technique to evaluate cellular uptake of viral nanoparticles.

技術優勢

Conventional ways for quantifying nano/micro particle uptake into mammalian cells involve both inductively coupled plasma atomic emission spectroscopy and inductively coupled plasma mass spectrometry. The disadvantage is they are limited to elemental species, such as gold nanoparticles (NPs). The technology based on cell mass spectrometry (CMS) provides a rapid and accurate method for determining the quantity of gold NP uptake into cells. It can determine the number of NP uptake on each individual cell whereas ICP only get a mean of all cells. In addition, it can be used to measure not only the cellular uptake of metal nanoparticles but also the non-metal nano/micro particles.

應用範圍

Nanoparticles whose intracellular concentration can be determines by CMS methods include polymeric nanoparticles (NPs), liposomes, viral-based NPs, carbon nanotubes, diamond NPs, polymeric micelles, nanocarriers, liposomes, and viral nanoparticles. The efficiency of drug delivery and intracellular titer of pathogens can be therefore determined.

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