Mass spectrometry imaging reveals the sub-organ distribution of carbon nanomaterials

With the supports from the National Natural Science Foundation of China and the Chinese Academy of Sciences, Prof. Nie Zongxiu's group at the Key Laboratory of Analytical Chemistry for Living Biosystems, Institute of Chemistry, Chinese Academy of Sciences, reported a general and label-free mass spectromic method, which can be applied in the quantitative imaging analysis of carbon nanomaterials in tissues of mice (*Nature Nanotech*, 2015, 10: 176—182).

Label and label-free methods to image carbon-based nanomaterials exist. However, label-based approaches are limited by the risk of tag detachment over time, whereas label-free spectroscopic methods have slow imaging speeds, weak photoluminescence signals and strong backgrounds. Here, they proposed a label-free mass spectrometry imaging method to detect carbon nanotubes, graphene oxide and carbon nanodots in mice organs (Figure). This method overcame the mass range limit of the conventional mass spectrometer for detecting large-molecular-weight nanoparticles by using the intrinsic carbon cluster fingerprint signal of the nanomaterials. They mapped and quantified the sub-organ distribution of these nanomaterials in mice. It was observed that carbon nanotubes and carbon nanodots were predominantly distributed in the outer parenchyma of kidneys, whereas the nanomaterials were predominantly detected in the red pulp of the spleen. The highest concentration of carbon nanotubes was found in the marginal zone of the spleen. These findings are helpful in exploring the detailed mechanisms governing carbon nanomaterial-biological interactions.

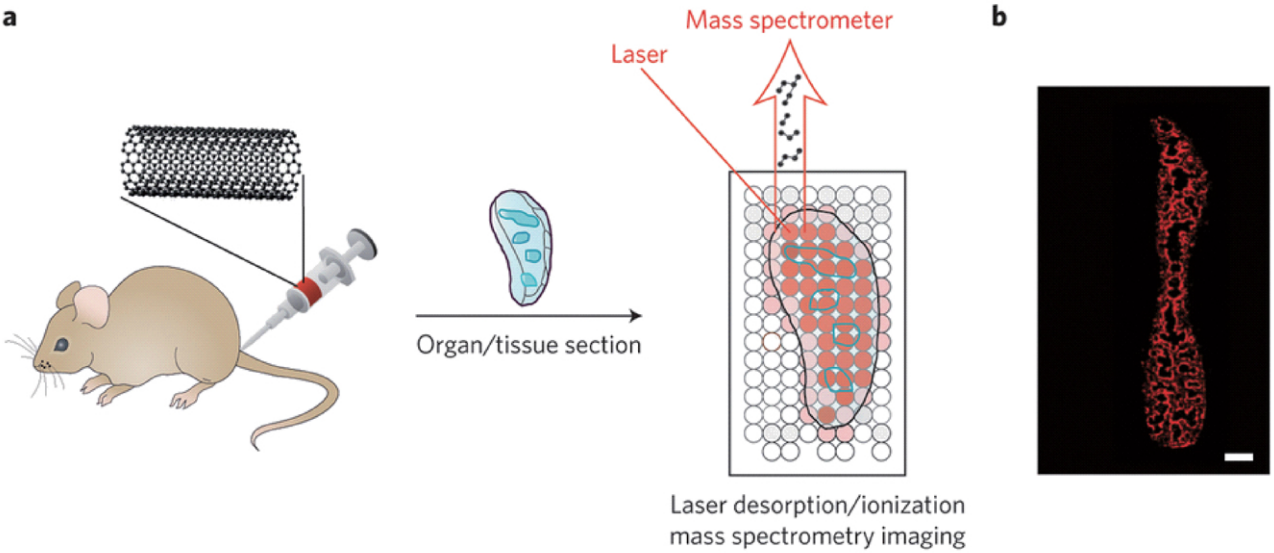

Figure Laser desorption/ionization mass spectrometry imaging of carbon nanomaterials in tissues. a, Carbon nanomaterials are injected into mice. The mice are killed, organs of interest are taken and sectioned, and laser desorption/ionization mass spectrometry is used to image the locations of the carbon nanomaterials. The laser is rastered across the tissue, and mass spectra are acquired at each spot. b, images are generated by plotting carbon cluster ion intensities as a function of location in the tissue. Shown here as an example is an image of a spleen from a mouse treated with carbon nanotubes. Red areas are where carbon nanotubes are found.