

Simultaneously separation of gold and silver nanoparticles and their ionic counterparts with thin layer chromatography

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The tremendous increasing use of engineered nanoparticles has raised concerns about their impact on the environment and in biological systems [1]. Among them, silver-containing and gold-containing material is of high industrial interest and of manifold use in consumer products. Therefore, analytical methods are urgently needed for the reliable determination of gold and silver nanoparticles and their ionic counterparts [2]. In this study, a novel method for separation and quantitative characterization of NPs in aqueous suspension was established by coupling thin layer chromatography (TLC) with laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS). It was found that TLC could allow simultaneous separation of differently sized gold nanoparticles (AuNPs) (13 nm, 41 nm), silver nanoparticle (AgNPs) (10 nm, 40 nm) with their ionic counterparts by using sodium dihydrogen phosphate anhydrous (0.5mM), Triton X-114 (0.05%, w/v), sodium dodecyl sulfate (0.013%, w/v), and formic acid (0.05%, w/v) as the mobile phase. Figure 1 depicts the characteristic Au and Ag signal profile obtained by LA-ICP-MS with line scanning along the separation channel. It was observed that smaller particles migrated faster than larger ones, whereas Au ions and Ag ions were completely migrated close to solvent front. Compared with the established method for the separation of metal nanoparticles, the developed TLC method is relatively simple and rapid.

Figure 1: LA spectrum showing the typical signal profiles observed for 48 ng AuNPs and AgNPs. (A) 13 nm AuNPs, 41 nm AuNPs and Au ions. (B) 10 nm AgNPs, 40 nm AgNPs and Ag ions. The scanning speed is 50 $\mu\text{m s}^{-1}$.

[1] Soto-Alvaredo, J.; Montes-Bayón, M.; Bettmer, J. *r. Anal. Chem.* 2013, **85**, 1316-1321. [2] Franze, B.; Engelhard, C. *Anal. Chem.* 2014, **86**, 5713-5720.