

Improved Single Particle ICP-MS Characterization of Silver Nanoparticles at Environmentally Relevant Concentrations

Karla Newman^{a*}, Chris Metcalfe,^a Jonathan Martin,^a Holger Hintelman,^a Phil Shaw,^b Ariane Donard^b

^a Water Quality Centre, Trent University, 1600 West Bank Drive, Peterborough, ON, K9J 7B8, Canada

^b Nu Instrument Ltd., 74 Clywedog Road South, Wrexham, LL13 9XS, UK

*corresponding author

Supplemental data

Accelerating voltage / V	6000
Forward rf power / W	1300
Coolant gas flow / L min ⁻¹	15.0
Auxiliary gas flow / L min ⁻¹	0.9
Make-up gas flow / L min ⁻¹	0.20
Nebulizer pressure / psi	33.5 – 33.9 ^a
Sample cone	Standard Ni 1.1 mm ø orifice
Skimmer cone	Standard Ni 0.7 mm ø orifice

^a Optimized daily

Table S1: ICP-MS instrument parameters.

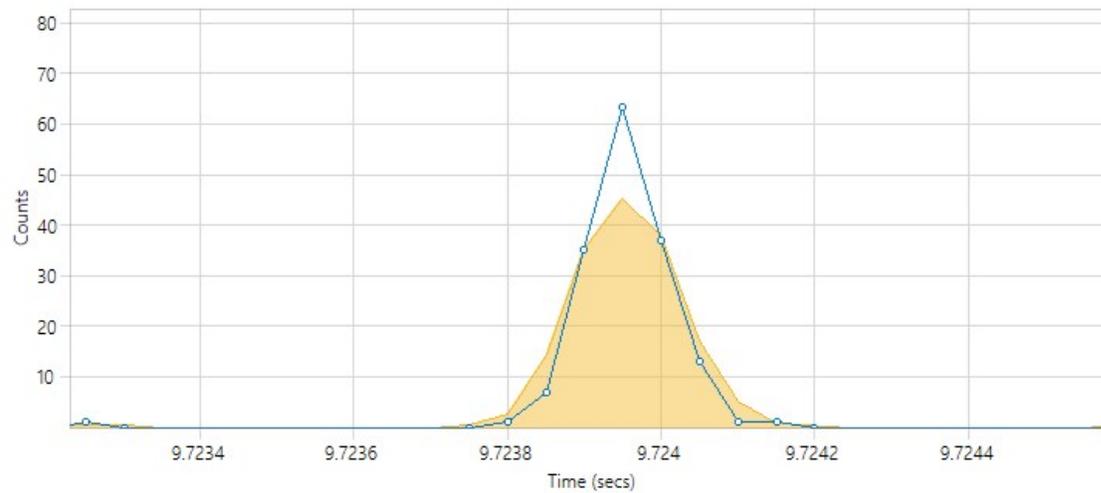


Figure S1: Peak profile for 20 nm Ag nanoparticle acquiring using a dwell time of 50 μ s. The shaded area indicates the 3 point 2 iteration rolling smooth; peak threshold = 4.

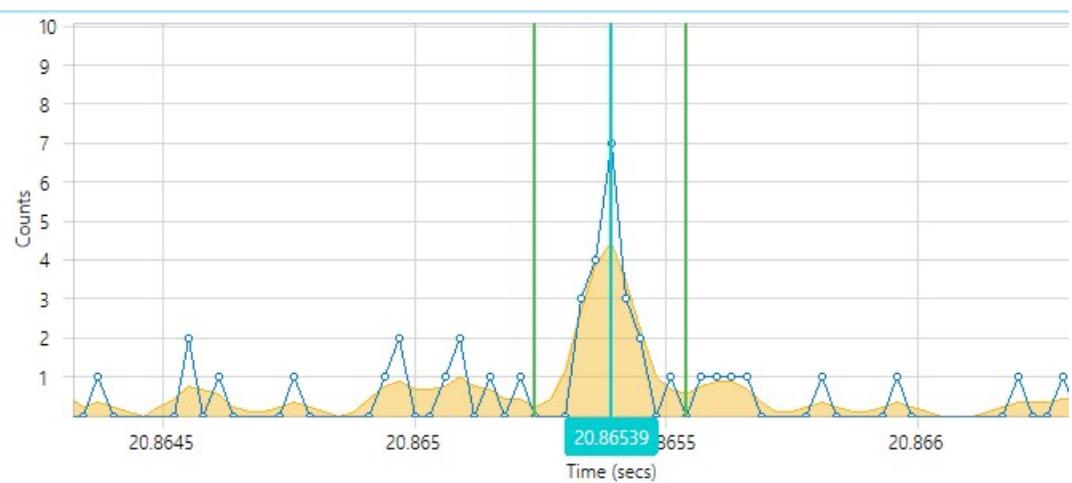
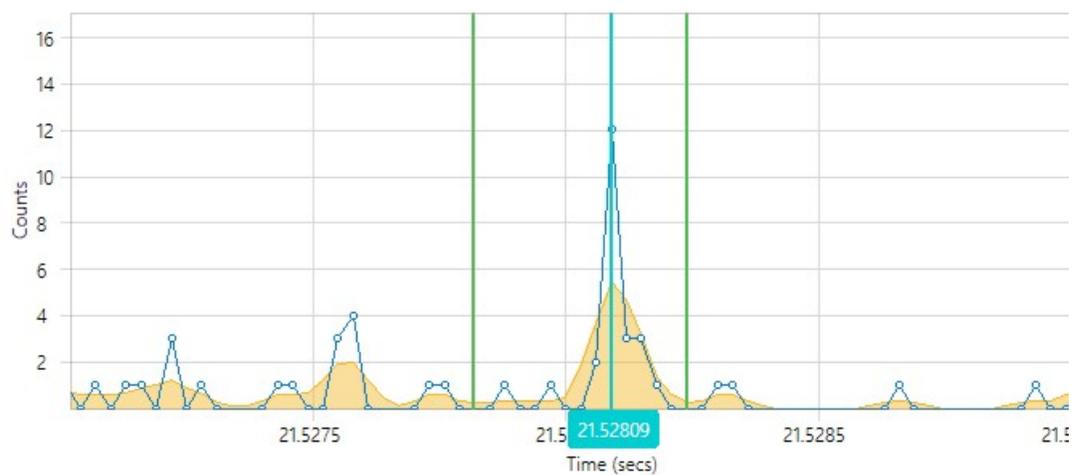


Figure S2: Raw spICP-MS data for 10 nm standard using a 30 μ s dwell time, peak threshold of 4 and 3 point 2 iteration rolling smooth (shaded area), green lines indicate peak start and end points found by the software a) example of a suspected false positive, reported particle diameter of 8.4 nm b) real particle event, reported particle diameter of 9.0 nm.

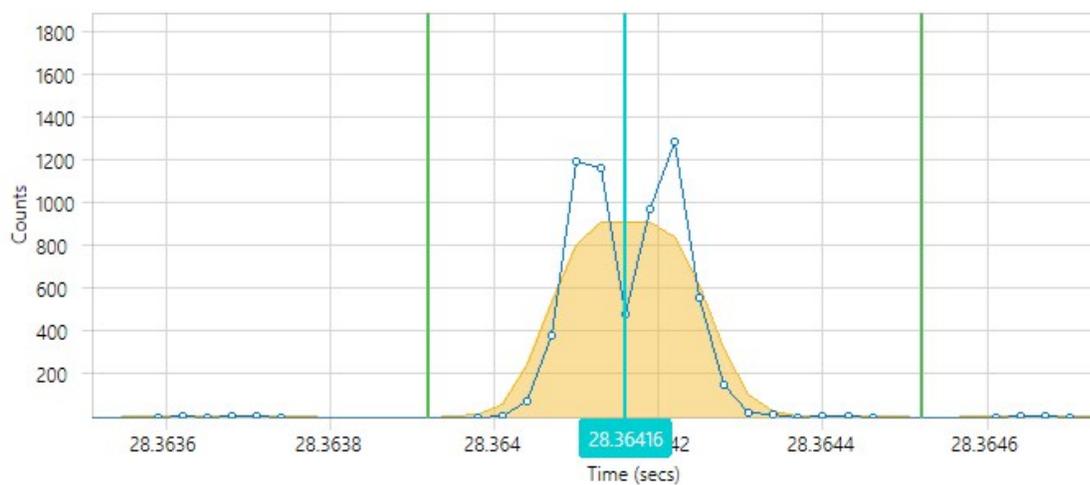


Figure S2: Raw spICP-MS data for 80 nm standard using a 30 μ s dwell time, peak threshold of 5 and 3 point 2 iteration rolling smooth (shaded area), green lines indicate peak start and end points found by the software. The peak maximum appears to be inverted due to saturation of the ion detector at very high count rates.

Standard	Size^a	Ag ng/ml^a	Particles/ml^a	Ag ng/ml^b	% Recovery	Corrected particles/ml
20 nm citrate	18.5	21000	6.10E+11	20501	97.6	5.4E+11
50 nm citrate	51.9	20000	2.60E+10	16279	81.4	2.1E+10
20 nm PVP	19.7	21000	4.90E+11	14917	71.0	3.9E+11
50nm PVP	50.2	21000	3.00E+10	19317	92.0	2.6E+10

^a Manufacturer values, ^b Measured value

Table S2: Comparison of manufacturer values for total Ag and particle number concentrations and total Ag concentration measured in this study (following nitric acid digestion on a hot plate of NP standards in Teflon vials); corrected particle concentrations determined using total mass of Ag measured here and the TEM particle size distribution (provided by manufacturer).