Supplementary Information (SI) for Analyst.

Table S1. Nitric oxide (NO) gas purity specifications and the Entegris WX gas purifier specifications.

Nitric Oxide specifications

Analytes	**Specification**	**Analytical Result**	**Analytical Uncertainty**
Nitric Oxide	≥ 99.5%	≥ 99.5%	± 5%
Nitrogen	≤ 2500 ppm	1042 ppm	± 5%
Carbon Dioxide	≤ 1000 ppm	≤ 100 ppm	± 5%
Nitrous Oxide	≤ 1200 ppm	129 ppm	± 5%
Water	≤ 20 ppm	≤ 20 ppm	± 5%

Entegris WX gas purifier specifications

Analytes	**Specification**
H_2O	< 100 pptV

Table S2. ICP-MS/MS Instrumental parameters used for all experiments.

	Operating condition					
Instrument parameter	**single gas flow**	**flow rate experiment**				
RF power (W)	1600			1600		
Sampling depth (mm)	3.0			3.0		
Nebulizer gas (L/min)	0.82			0.76		
Spray chamber temp (c)	2			2		
Makeup gas (L/min)	0.23			0.27		
Plasma gas (L/min)	18			18.0		
Auxillary gas (L/min)	0.9			0.9		
Extract 1 (V)	6.5			5		
Extract 2 (V)	-250			-250		
Omega Bias (V)	-200			-200		
Omega Lens (V)	16.0			17		
Q1 Entrance (V)	-1.0			-1.0		
Q1 Exit (V)	-1.0			1.0		
Q1 Bias (V)	-1.0			-1.0		
Plate Bias (V)	-70			-70		
Cell gas flow (mL min^{-1})	0.89	**0.0**	**0.22**	**0.45**	**0.89**	**1.49**
Deflect (V)	-10.0	20.0	13.0	4.0	-3.0	-15.0
Octopole Bias (V)	-20.0	-8	-1.0	-10.0	-15.0	-25.0
Axial Acceleration (V)	2			2		
Octopole RF (V)	180			180		
Energy Discrimination (V)	-10			-10.0		
Wait Time Offset (msec)	5			5		

Table S3: Normalized total ion transmission (sum of all Q2 products; purified signal/non-purified signal) for each Q1 analyzed at 0.89 mL min^{-1} NO. Those > 1.0 show signal enhancement when the purifier is used. Those < 1.0 (bold/italicized) show decreased total ion transmission when the purifier is used.

Element	Normalized Signal
Li	4.42
Be	28.75
Be	3.25
Na	1.36
Mg	***0.92***
Al	1.80
K	1.43
Ca	1.58
Sc	2.87
Ti	14.89
V	14.27
Cr	23.66
Fe	40.91
Mn	2.68
Ni	3.29
Co	9.92
Cu	1.46
Zn	***0.74***
Ga	1.29
Ge	2.46
Se	1.53
As	1.71
Sr	***0.95***
Rb	1.35
Y	1.62
Zr	4.05
Mo	10.52
Nb	3.39
Ru	15.43
Pd	1.34
Cd	1.24
Ag	1.40
Sn	3.19
In	1.23
Ba	1.36
Cs	1.21
Ce	1.03
La	1.27
Pr	1.09
Nd	1.78

Sm	1.72
Eu	***0.96***
Gd	1.98
Dy	1.63
Tb	1.46
Er	1.54
Ho	1.74
Yb	1.01
Tm	1.47
Hf	3.05
Lu	1.56
Ta	1.31
W	3.62
Re	5.15
Pt	16.21
Ir	6.40
Au	1.72
Tl	1.31
Pb	1.06
Bi	1.42
Th	***0.64***
U	1.84

Table S4: Isotopic ratios of oxygen for M+17/M+16, M+33/M+32, M+34/M+32 and M+35/M+32. Bolded ratios match that of oxygen and products are expected to be caused by the natural abundance of oxygen. Ratios listed as "no xxx" (MO, MOH, MO_2, etc.) denote that the product listed was not observed in the spectrum (0 cps); thus, the signal observed is expected to be solely due to the impurity products.

	17/16		**33/32**		**34/32**		**35/32**	
Element	**non-purified**	**purified**	**non-purified**	**purified**	**non-purified**	**purified**	**non-purified**	**purified**
Expected ratio	0.00040		0.00080		0.004		2E-05	
Li								1.6E-01
Be								no MO2
Be								
Na								
Mg	no MO	no MO						
Al	no MO	no MO						
K								
Ca	0.67	no MOH						
Sc	0.076	0.022	no MO_2	no MO_2	no MO_2	no MO_2H_3		
Ti	0.025	no MOH	no MO_2	no MO_2				
V	0.19	0.042	0.66	0.90				
Cr	0.66	1.12	no MO_2	no MO_2H				
Fe	0.40	0.31						
Mn	no MO	no MO						
Ni	no MO	no MO						
Co	0.39	0.73						
Cu								
Zn	no MO	no MO						
Ga								
Ge	6.5	0.77						no MO2
Se							No MO2	
As								
Sr	0.84	0.16						
Rb								
Y	0.017	no MOH	no MO_2	no MO_2	no MO_2	no MO_2H_3		
Zr	0.0032	no MOH	0.65	0.12			9.1E-03	7.6E-04
Mo			0.25	no MO_2H				
Nb			0.15	0.26				
Ru	0.40	0.76	no MO_2	no MO_2H				
Pd								
Cd								
Ag								
Sn	no MO	no MO						
In								

Ba	0.42	0.072						
Ce			1.6	2.4	0.12	no O2H2		5.5E-03
La							3.2E-02	
Pr	0.0068	no MOH	no MO_2	no MO_2	no MO_2	no MO_2H_3	No MO2	
Nd	0.13	no MOH	no MO_2	no MO_2H			2.3E-02	
Sm	0.340	no MOH						
Eu	0.47	no MOH						
Gd	0.016	no MOH	no MO_2	no MO_2H	no MO_2	no MO_2H_3	No MO2	
Dy	0.18	no MOH						
Tb	0.026	no MOH	no MO_2	no MO_2H				
Er	0.17	no MOH						
Ho	0.18	no MOH						
Yb	0.58	no MOH						
Tm								
Hf	0.0029	no MOH	0.51	0.10				1.1E-03
Lu	0.12	no MOH						
Ta			0.21	0.22				
W			0.21	0.035	0.038	no O2H2		
Re	0.34	no MOH						
Pt								
Ir								
Au	0.17	no MOH						
Tl								
Pb	no MO	no MOH						
Bi								
Th	**0.00058**	**0.00039**	0.31	0.095	**0.0061**	**0.0040**		4.9E-03
U	**0.00065**	no OH	0.0070	0.0016	**0.0036**	**0.0035**	8.1E-03	2.9E-05

Table S5: The % probability an ion with a given mass (M^+) to experience 0 to 40 collisions in the CRC pressurized with NO at a) 0.22 mL min^{-1}, b) 0.45 mL min^{-1}, c) 0.89 mL min^{-1}, and d) 2.49 mL min^{-1}. The summary shows a parameter 'j' which is the most probable number of collisions (highest probability) for each gas flow.

Data is shown in attached excel spreadsheet due to size limitations.

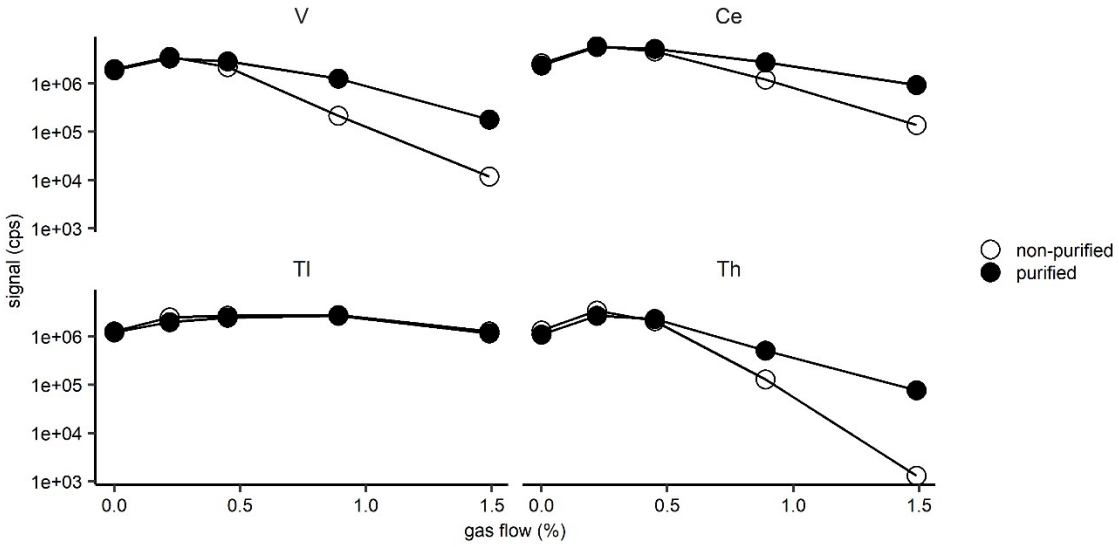

Figure S1: Total ion transmission for ^{51}V, ^{140}Ce, ^{205}Tl, and ^{232}Th as a function of NO flow (mL min^{-1}) with (filled points) and without (open points) the gas purifier. Note that the ThO_3 and respective oxy-hydrides are note measured due to the Q2 *m/z* limitations.