

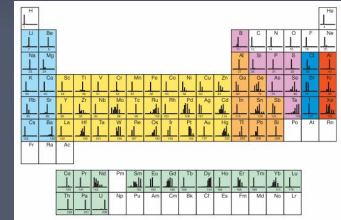
An overview of ICP-MS and its Applications in The State Laboratory

Dr. John Fields

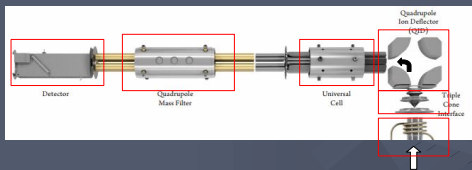


What can ICP-MS measure?

- Multi Element
- Low sensitivity - ppt
- Large working range

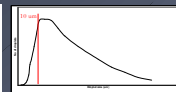


How does ICP-MS work?



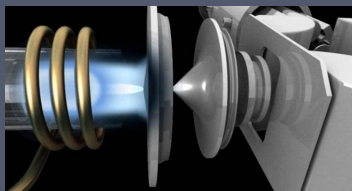
Sample Introduction

- Nebuliser - concentric
 - cross flow
 - babington
- Spray Chamber - scott
 - cyclonic



Inductively Coupled Plasma

Argon / RF Coil
6000 °C

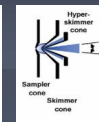
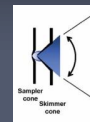


Liquid → Solid → Gas → Ions

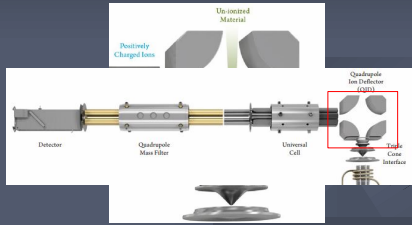


Sampling Interface - Cones

- High Temp → Room Temp
- Pressure → Vacuum

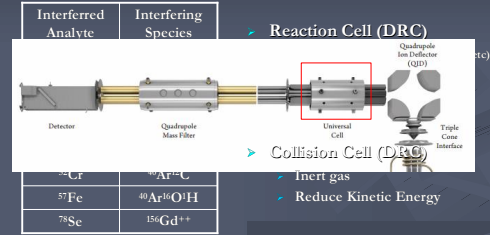


Separating Ions - QID



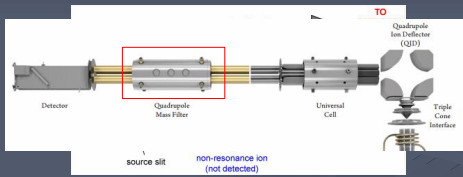
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Spectroscopic Interferences – Cell Technology



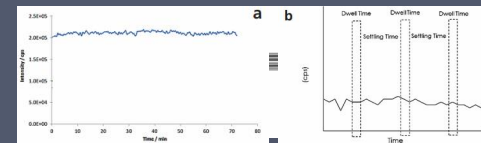
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Separating Ions – Mass Spectrometer



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Detecting Ions



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Applications of ICP-MS in The State Laboratory



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Animal Feedingstuffs Section

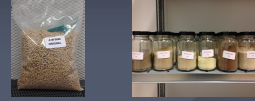
- Principal Irish laboratory monitoring compliance of Animal Feedingstuffs with EU and national legislation
- Emphasis on food safety & animal welfare – proximates, medicines, trace & heavy elements
- Fulfil role as EU NRL for Heavy Metals in Feed Additives Animal Feed
- >70% of The State Laboratory's accredited tests
- Regulatory analysis of Fertilisers and Limestones

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Regulations

- Trace Elements – Cu, Co, Mn, Mg, Zn, P, Na, Ca, I
Comm Reg (EU) 152/2009 – AA
I.S. EN 15621:2012 – ICPAES
I.S. EN 15111:2007 – Iodine by ICPMS
- Heavy Elements – As, Cd, Co, Pb, Se, Hg
EN 15550:2007 – GFAAS
JOAC, Vol 65 (3) 1982 - HGAAS
- Fertilisers & Limestone – P, K, S, Na, Ca, Mg
I.S. EN 15691:2011

Sample Preparation & Digestion

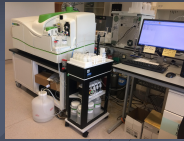


Multi-Element Analysis by ICP-MS



Elan DRCe

- As, Cd, Co, Pb, Se (DRC)
- Hg (Au)
- I

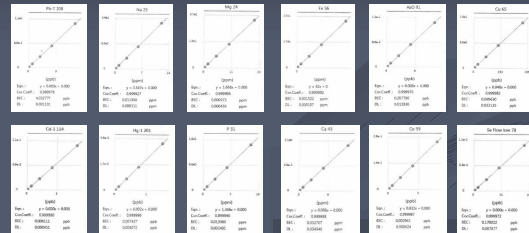


NexION 350x

- P, Ca, Co, Mo, Pb, Tl, U
- Na, Mg, Fe, Mn, Cu, Zn (KED)
- As, Cd, Hg, Se (DRC)

Quantitative Analysis

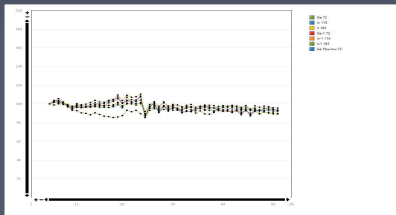
Calibration Curve



9 orders of magnitude (ppb - %)

Quantitative Analysis

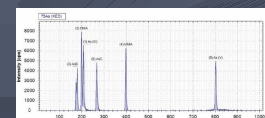
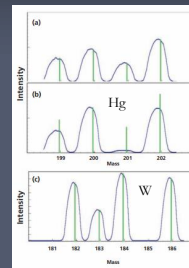
Internal Standards (In, Ir, Ge, Se, Ga, Rh, Bi etc)



Monitor cps throughout the run to observe
the effect of the sample on the plasma

Isotope Ratio

IC-ICP-MS

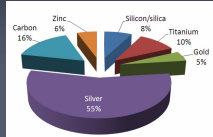


Nanoparticles



Lycurgus Cup 400AD

Definition of a Nanoparticle:
<100nm



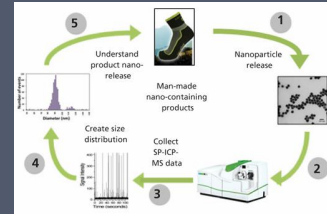
Nanomaterials used today



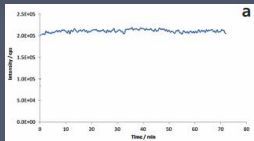
Characterising Nanoparticles

Rapid simultaneous characterisation of the nanoparticles elemental composition, the number of particles, their size and size distribution

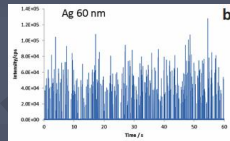
Inorganic particles – sp-ICP-MS



ICP-MS v sp-ICP-MS

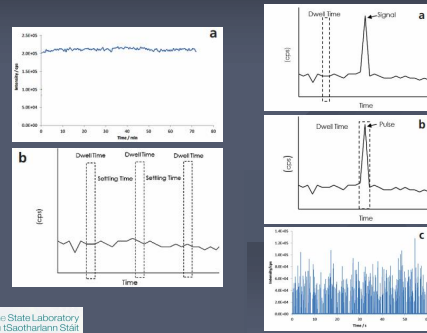


Dissolved analyte

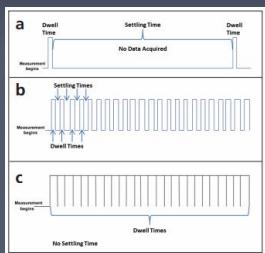


60nm silver nanoparticles

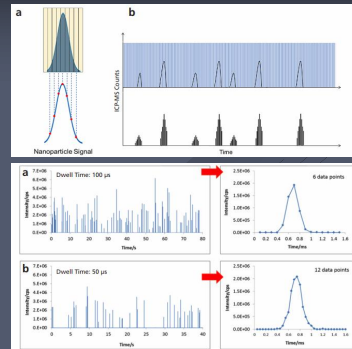
sp-ICP-MS Detector Capability



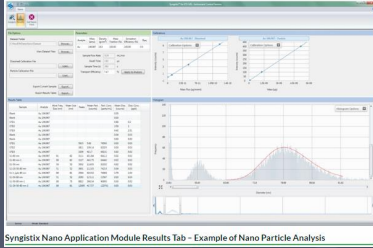
sp-ICP-MS Detector Capability



sp-ICP-MS Detector Capability



sp-ICP-MS Nano-app by Perkin Elmer



Questions?

Thanks

All the staff in the
Animal Feedingsuffs Section
at The State Laboratory