Preparation of Microparticle Reference Materials for Nuclear Safeguards Particle Analysis

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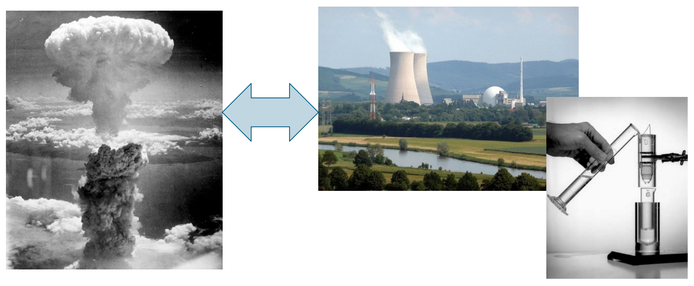
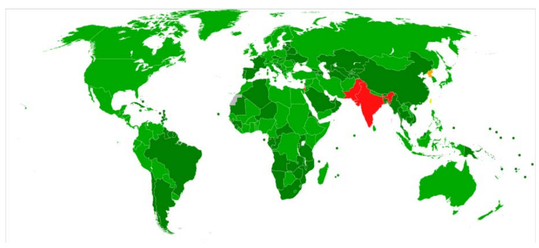
Background

Dual-use nature of nuclear technology requires attention to non-proliferation.

Military use — Civil use



Non-Proliferation Treaty (NPT)
- In force since 1970, today: 190 members
- IAEA controls the peaceful use of through application of “Safeguards”



Nuclear safeguards:
- Verification measures to deter states from the misuse of nuclear material and facilities
- Inspections at nuclear facilities by IAEA

Particle Analysis in Nuclear Verification

Environmental swipe sampling supports the IAEA detection of undeclared activities.

Source: IAEA

Source: IAEA

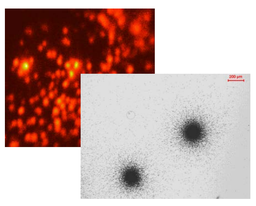
Detection of traces from enrichment and reprocessing activities through Highly sensitive analysis of actinides.

Particle analysis on swipe samples

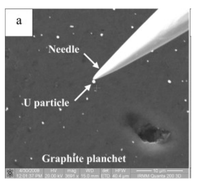
Screening
- γ-spectrometry
- XRF

Particle extraction
- Vacuum impaction
- Ultrasonic bath

Identification
- Fission Track
- SIMS

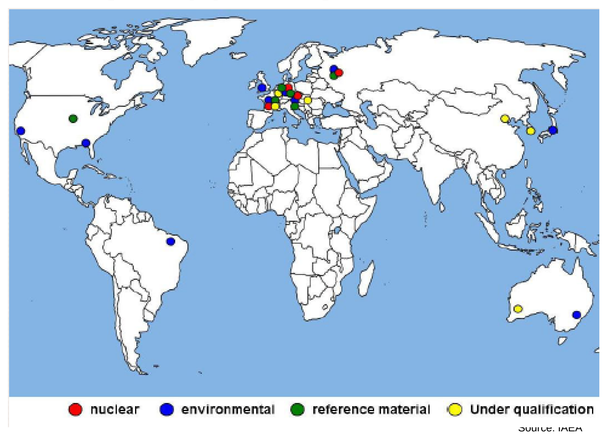


Isotope analysis
- TIMS
- SIMS



IAEA Network of Analytical Laboratories (NWAL)

Laboratory support by member states:



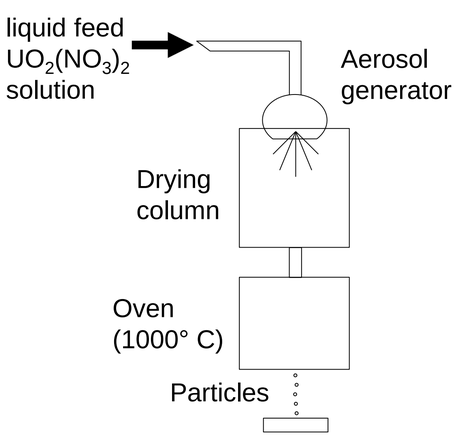
Source: IAEA

IAEA requires dedicated reference material for Quality Assurance and Quality Control

Reference Material for Particle Analysis

Particle Production

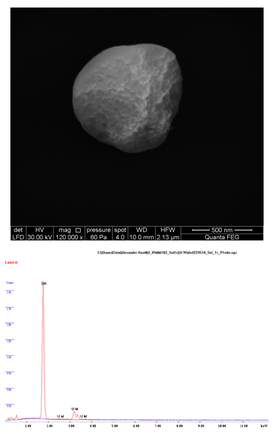
Particles with uniform properties:
- Size
- Elemental Content
- Isotope Ratios
- Chemical Composition



Particles produced at IEK-6

Micrograph (200×) of U microparticles

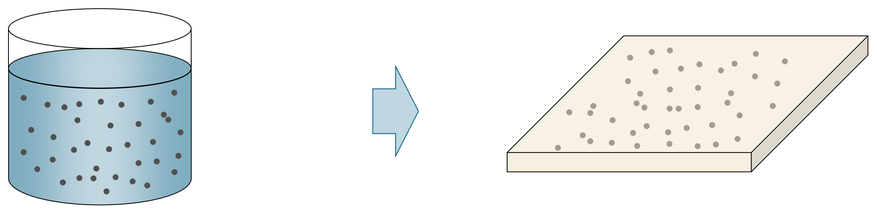
U-oxide Particle (SEM)



Microparticle Reference Material

Preparation of uniform particles according to the requirement of the analytical technique:
- For easier handling/transport/storage
- Particles on substrate or homogeneous in matrix

Draft Concept:



(1) Particles dispersed in solution

(2) Solid matrix with embedded particles

Investigation of material stability:
- Particle stability
- Matrix stability
- Particle-Matrix interactions

Member of the Helmholtz Association

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