

Online determination of size distribution and elemental composition of nanoparticle aerosols by a scanning mobility particle sizer coupled to an inductively coupled plasma mass spectrometry (SMPS-ICPMS)

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Motivation

The chemical and physical characterization of particles from micrometer down to the nanometer range is of prime importance in many fields including air quality control, assessment of combustion processes and production of engineered nanoparticles. All nowadays used techniques are either offline methods and/or cannot provide simultaneously chemical and physical information

SMPS (scanning mobility particle sizer)

- SMPS = DMA (differential mobility analyzer) + CPC (condensation particle counter)
- Size distribution of aerosol particles
- Concentration of aerosol particles

ICPMS (inductively coupled plasma mass spectrometer)

- Trace and ultra-trace elemental analysis
- Offline (routine) analysis of (digested) liquid samples

Objectives & Benefits

- **Coupling SMPS to ICPMS**
- Online characterization of particle aerosols
- Simultaneous information about chemical composition and size distribution of particles in an aerosol
- Avoiding contamination and/or morphology alteration of the particles

Coupling Concept

- Argon as carrier and sheath gas (for SMPS) instead of air (due to the low oxygen tolerance of the ICP plasma)

RDD (rotating disk diluter RDD)

- Aerosol flow introduced into SMPS can be well predefined and fixed independent of the source aerosol flow

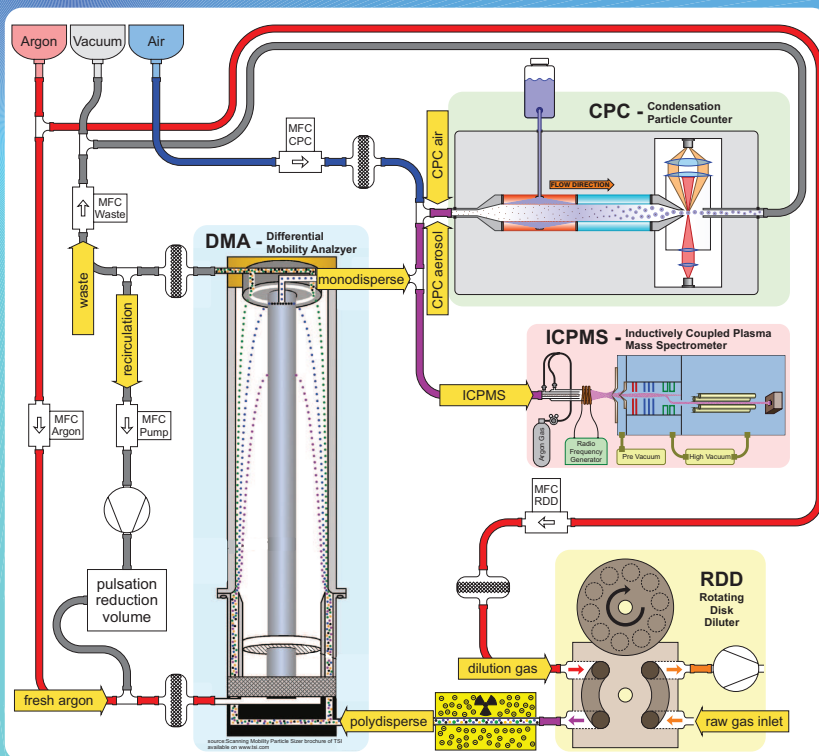
Measurements

- Model aerosols generation:
- Aqueous NP suspension --> Nebulizer --> Aerosol dryer into
- Treatment of resulting dry NP aerosol
- Subsequent RDD dilution --> Introduction into SMPS-ICPMS
- Measurement of gold and silver nanoparticle mixture

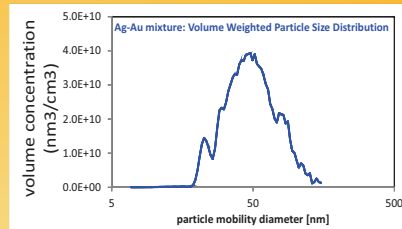
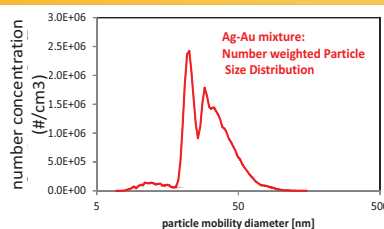
Conclusion

- Good correlation between ICPMS transient signal and SMPS particle volume concentration
- The hyphenated SMPS-ICPMS allowed identifying two types of nanoparticles with different nominal diameters in an aerosol mixture

Gas flow and coupling concept of SMPS and ICPMS



Results



Number based SMPS signal

Volume weighted particle size distribution

ICP & SMPS signal correlation

Resolving Ag & Au nanoparticles

