Application of Miniature Mass Spectrometers for Real Time Hydrogen and Hydrogen Isotopic Measurements

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Needs and Tasks

- Hydrogen Applications
 - Safety 4% LEL
 - Radiolysis pressurization, off-gas,
 - Storage monitors and storage materials
 - Isotopic separations
- Identify, Acquire, Design, Develop, and Implement Analytical Instrumentation
 - Plant operations [highest priority]
 - Experimental Research [more common]

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New Instrumentation

- Working with vendors
 - Swagelok IGC II modules
 - Air Squared small dual stage scroll pump
 - Mini Turbo Pumps
 - Pfeiffer mini 2x2x6 pump, DCU unit, controller card
 - Alcatel ACT 30+, turbo with molecular drag stages
 - RGA manufacturers
 - Mass Sensors
 - Ferran Instruments
 - Pfeiffer/Balzers Prisma QME 200 and Quad 421 series
 - Stanford Research Systems RGA 300







Gamma Radiolysis Study of the Rate of Hydrogen Generation



Equipment: SRS RGA 300, Swagelok IGC II preumatic valves, National Instruments Field Point Serial Relay control, Microsoft Visual Basic.Net w/in-house sofware and National Instruments Component Works for ActiveX Graphics and I/O control



















ORNL Design Ion Trap

Amptek Detector

Alcatel Pump

Henry Radio Brick Amplifier [HAM RadioDan] [2-27 Mhz]











Mass Sensors ExB Mini Mass Spectrometer











😿 Cyberspec Controller (connected to 129.58.73.195)

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Ferran Scientific Micropole Advantages small size high pressure sensitive







Hydrogen and Deuterium Mixture As Seen on a Ferran Micropole



We used two Ferran micropoles in a differential measurement mode.

This system determines the permeation rate of deuterium through materials of interest in a processing plant.

The system is pressurized on the lower chamber and evacuated on the upper chamber. The time to "break-through" is determined using the Mass Spectrometers.







We are using a Pfeiffer Prisma QME 200 to look at hydrogen isotopes in flow through bed experiments.





This is a configuration test setup for a Pfeiffer/Balzer Quad QMS 421 which is used for real-time measurements in our plant facilities.







The Raman Spectroscopy Alternative



Commercial fiber-optic probe

Compact, portable turn-key laser -- 488 nm

Simple set-up

Verification of the Raman Signal by Mass Spec



Peak ratio comparisons

	H ₂ :D ₂	D ₂ :HD	H ₂ :HD
MS	0.65	0.67	0.44
Raman	0.70	0.77	0.50
	7%	15%	14%



Conclusions

 Savannah River needs analyzers to support hydrogen technologies

 Savannah River will work with vendors to test, develop, and use the best available technologies for applications at the site

