

March 28, 2005

■ **Exam #2: Results!**

- Range: 109 - 197
- Average: 167.9/200 (84%)
- Median: 171.5/200

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Spectrometers for AES

- **Highest possible resolution** gives best L/B, so invest in instrument with *high dispersion*
- For **simultaneous multi-element** determinations: use multichannel spectrometer (direct reader or echelle)
- **With AES, you obtain a spectrum**
 - qualitative analysis possible
 - easy background correction

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Applications

✓ **Qualitative Analysis**

- AES only (no spectrum with AAS)

✓ **Quantitative Analysis**

➢ **Calibration Curves**

- **AAS:** 1-2 decades LDR (limited by stray light)
- **AES:** 6-7 decades LDR (with ICP)
 - Deviations at *high concentrations* due to self-absorption
 - Deviations at *low concentrations* due to ionization (%-ionization greatest at low conc, so atom line emission depressed more at low concentrations)

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Interferences

■ **Ionization**

-signal will vary with %-ionization (a function of e^- number density):



-*easily ionizable elements* (e.g., Na, K, Li, etc.) will be more significantly ionized than other elements

-the presence of an *EIE* in a sample will affect the electron density, shifting the ionization equilibrium of the *analyte* and affecting the resulting signal, leading to an: **Easily Ionizable Element Interference Observation**

EIEIO

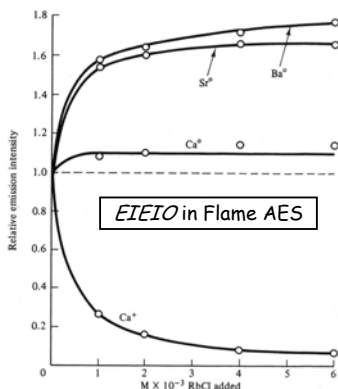
So, it's the *variability* of the e^- density that is problematic

Solution:

-*flood* system with an EIE to give a large, constant e^- density

-**Flames:** add *ionization suppressant*

-**ICP:** *no EIEIO!*

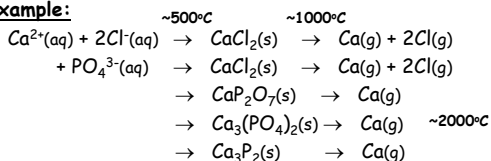


Atomization Interferences

■ **Cooler sources are high-temperature reaction cells**

-sample matrix can provide species which react with analyte to reduce signal

Example:



-also a problem with other matrix elements (e.g., SO_4^{2-} , $\text{C}_2\text{O}_4^{2-}$, Al, etc.)

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Atomization Interferences

Again, the *variability* of the interferent is the problem

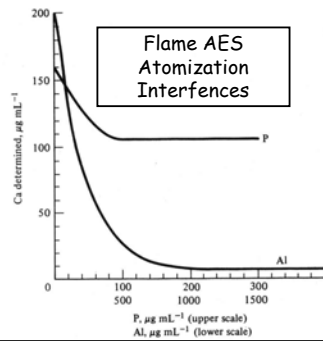
Solutions:

1. Chemistry

- Add a *releasing agent*
- Add a *complexing agent*

2. Higher Temperature

- hotter flame
- ICP*



AES versus AAS

GF-AAS

- low cost
- single element
- low sample throughput
- atomization interferences

ICP-AES

- moderate-high cost
- multielement
- high sample throughput
- spectral interferences

Complementary Techniques

- *together*, can get *low-to-sub-ppb* det. limits for ~70 elements