ATOMIC ABSORBANCE SPECTROSCOPY

SDSU CHEM 251
ATOMIC ABSORBANCE SPECTROSCOPY (AAS)

- AAS is similar to molecular absorbance spectroscopy, with the obvious distinction that **AAS is focused on atoms**, not molecules.

- As such, **samples are destroyed** in the process of the analysis, as they must be broken down to their component atoms.

- The benefit is that atoms have much more **limited, and specific absorbance spectra**, as compared to molecules, so more selective analyses can be made.

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**Iron-phenanthroline complex absorbance spectrum**

**Sodium absorbance spectrum**
ATOMIZATION

- To decompose the analyte into individual atoms, the sample must be heated, a lot.
- Flame AAS instruments use a nebulizer to make tiny droplets of the liquid sample, before entering the flame.
- The light to be absorbed is passed along the length of the burner (10 cm path length).
- Flame AAS instruments consume large amounts of liquid sample for an analysis and only about 95% gets to the flame.

<table>
<thead>
<tr>
<th>Table 10.9 Fuels and Oxidants Used for Flame Combustion</th>
<th>Temperature range (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>fuel</td>
<td>oxidant</td>
</tr>
<tr>
<td>natural gas</td>
<td>air</td>
</tr>
<tr>
<td>hydrogen</td>
<td>air</td>
</tr>
<tr>
<td>acetylene</td>
<td>air</td>
</tr>
<tr>
<td>acetylene</td>
<td>nitrous oxide</td>
</tr>
<tr>
<td>acetylene</td>
<td>oxygen</td>
</tr>
</tbody>
</table>
ELECTROTHERMAL ATOMIZERS

- Electrothermal (graphite furnace) instruments do not use a flame, but rather resistive heating to atomize the sample.
- They can accommodate solid and liquid samples.
- Only take 5-50 µL of sample.
- Gasses can be purged from the furnace prior to final atomization.

Temperature Program

Figure 10.45
Diagram showing a cross-section of an electrothermal analyzer.
LIGHT SOURCE

• As with all absorbance measurements a light source is required.

• Unlike molecular absorbance a regular light source will not suffice.

• Regular light sources, even with a monochromator, have too broad an emission spectra. This means the atoms will not absorb enough light for it to be noticeable by the detector.
HOLLOW CATHODE LAMP

• **Hollow cathode lamps** are specialized lamps made from the metal of interest for the analysis.

• They emit light is **narrower in wavelength** than what the atoms will absorb. This is because the **atoms in the lamp are colder** than the atoms in the flame or furnace.

• This ensures that if an atom can absorb the light it will, but a **different lamp is needed for each element to be analyzed**.