Atomic and laser induced breakdown spectroscopy

This is a way to look at the atomic constituents of an analyte

- Two main processes:
  - Emission
  - Absorption
- Question how do we make atoms emit radiation?
- Atomic lines tend to be fairly narrow

Atomic Absorption Spectroscopy

- A volatilized sample is ignited, and a narrowband light source is used to look for absorption features
- Narrowband sources are needed, because the absorption features are broad
- You use a light source that corresponds to the element you are looking for. Absorption is characteristic to the element

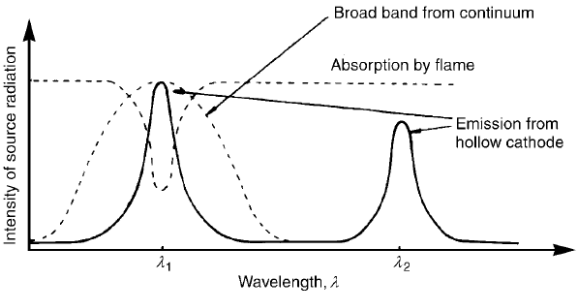
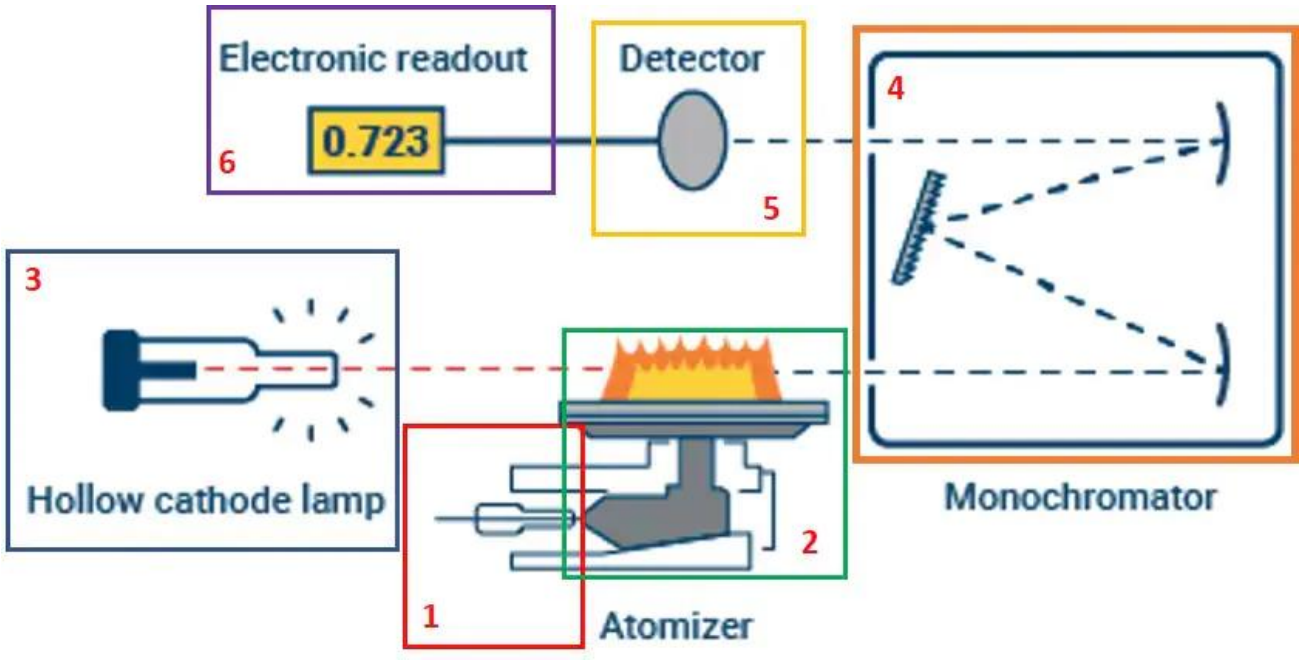
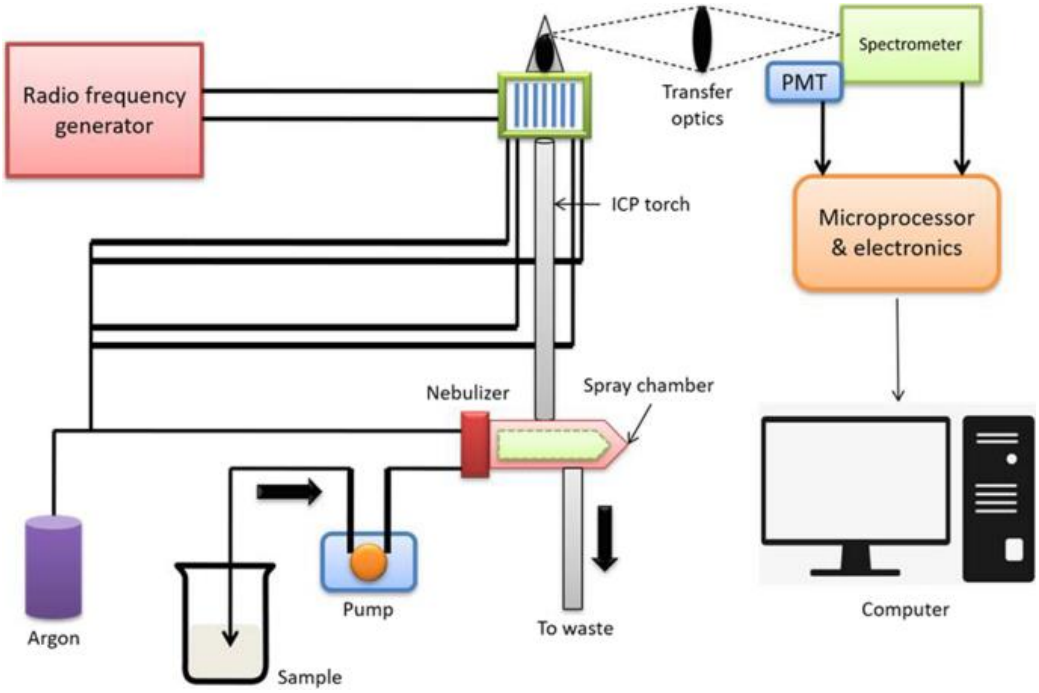


Figure 3.20 The principle of atomic absorption spectroscopy



Atomic Emission Spectroscopy

- Sample is put into an excited state and emissions are recorded
- Common methods:
  - laser induced breakdown spectroscopy (this gets its own slide)
  - inductively coupled plasma atomic emission spectroscopy (ICP-AES)
- In ICP-AES the aerosolized analyte is ignited into a plasma flame by heating it with a large amount of RF radiation (talking kilowatts here)
  - Energized sample then emits radiation

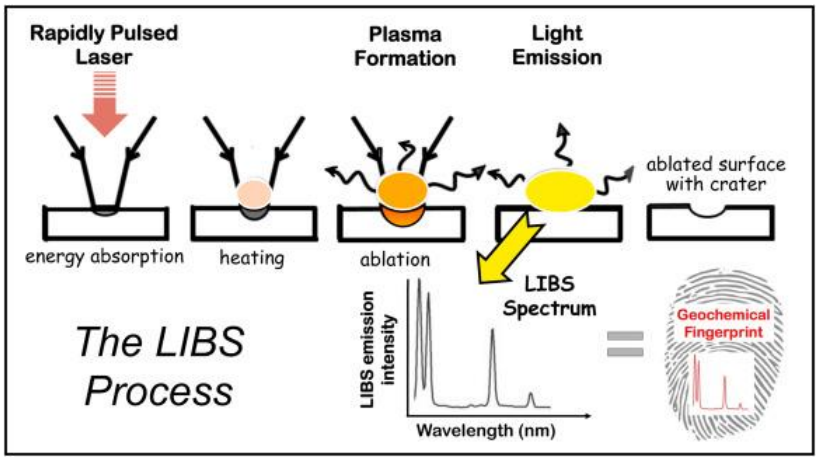


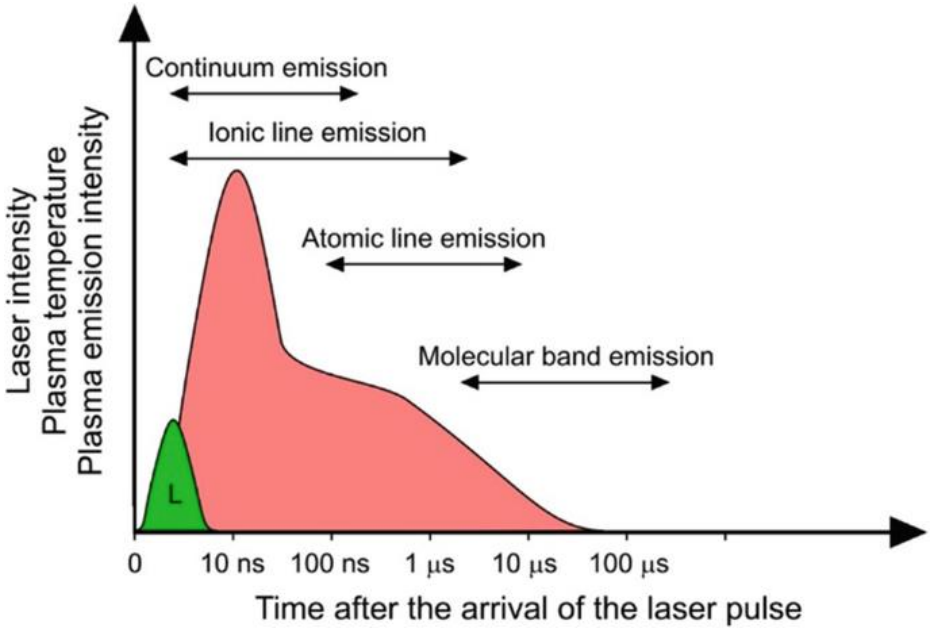
Laser induced breakdown spectroscopy (libs)

- A sample is turned into a plasma by illuminating it with an intense laser pulse (50+ mJ usually)
- Plasma returns to ground state and emits radiation
- Two main regimes nanosecond and femtosecond libs
- Nanosecond:
  - Small amount of material is ablated by the initial portion of a high energy pulse, the tail end then heats it into a plasma.
  - Has a “heat affected zone” small crater on surface, pretty messy on a microscopic scale
- Femtosecond:
  - The high electric field causes dissociation and ionization of the analyte. Direct generation of the plasma
  - No heat affected zone, very neat crater on microscopic scale
- TIMING IS IMPORTANT, NEED TO LOOK AT JUST THE RIGHT TIME FOR THE RIGHT EMISSIONS

LIBS continued

- Lots of different games you can use to increase the signal:
  - Double pulse libs; basically you use a second laser pulse to reheat the plasma that's ignited
  - Controlling the environment its occurring in can lead to longer lived plasmas
  - Obviously more power gives more plasma





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