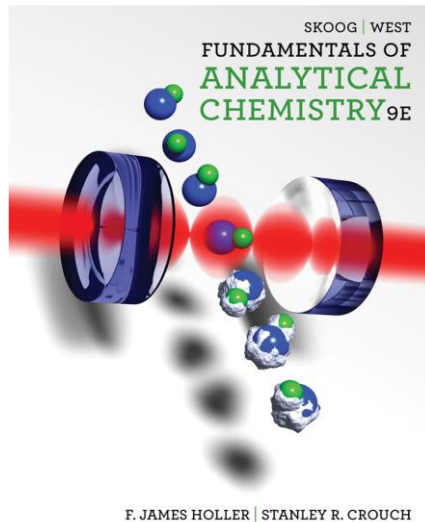


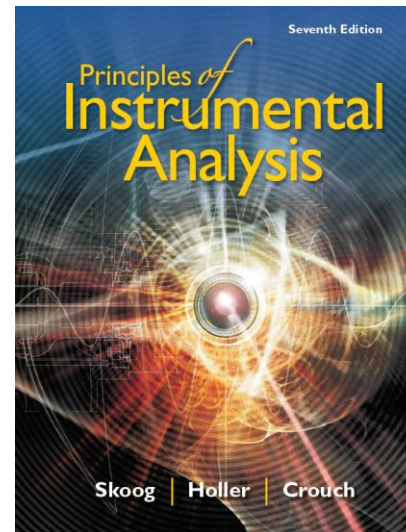


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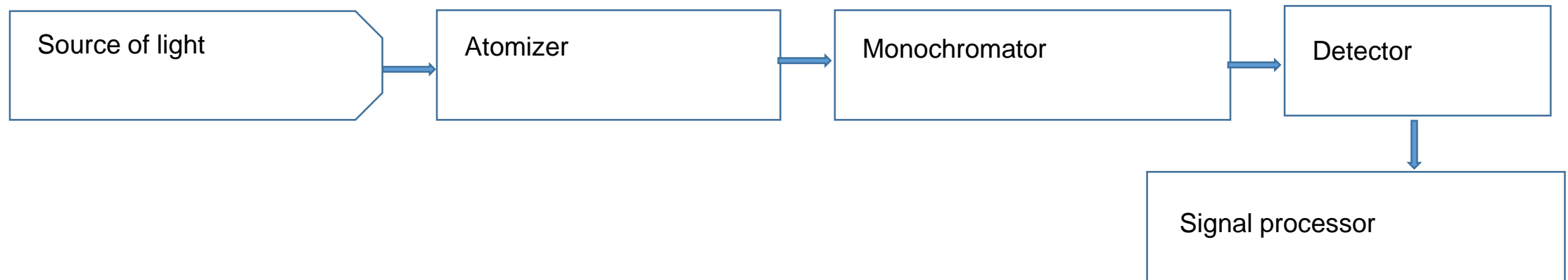
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ATAKOL's lecture
notes

1. Skoog, D.A., West, D.M., Holler, J.F., Crouch, S.R. 2013. Fundamentals of Analytical Chemistry (9E). Cengage Learning, Belmont, USA.
2. Skoog, D.A., Holler, J.F., Crouch, S.R. 2016. Principles of Instrumental Analysis (7E). Cengage Learning, Boston, USA.
3. Prof. Dr. Orhan ATAKOL's lecture notes.

Atomic Absorption Spectroscopy (AAS)

The simple representation of the AAS instrument is as follows:



BEAM SOURCES

There are 4 kinds of beam source:

1- Hollow Cathode Lamps

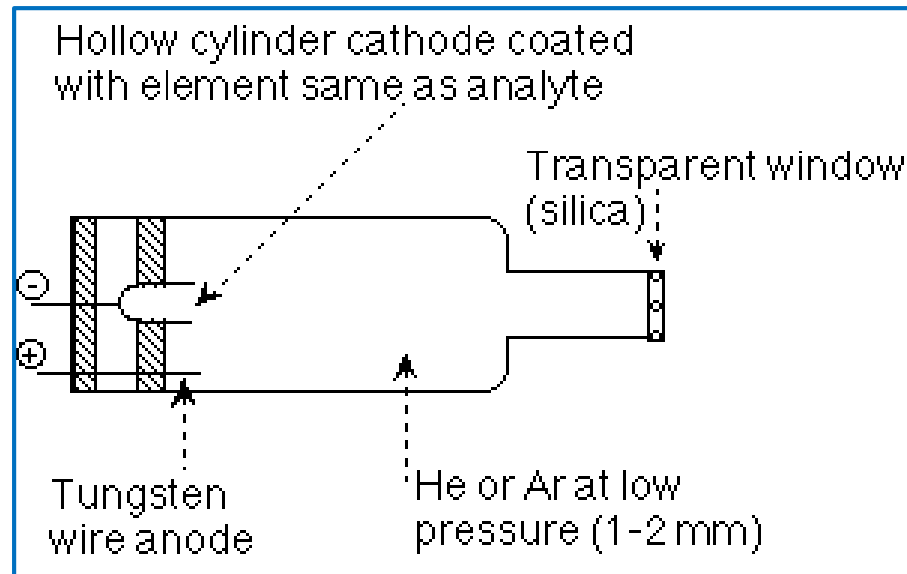
2- Super Lamps

3- Xenon Lamps

4- Electrodeless discharge lamps

1. Hollow Cathode Lamps

The most useful radiation source for atomic absorption spectroscopy is the **hollow-cathode lamp**. It consists of a tungsten anode and a cylindrical cathode whose surface is coated with the element to be analyzed. These electrodes are sealed in a glass or quartz tube containing an inert gas, such as argon, at a pressure of 1 to 5 torr. The cathode either is fabricated from the analyte metal or else serves as a support for a coating of that metal.



During the operation of the lamp, a direct current of 300 V is applied between the anode and cathode. With this electric current, the inert gas in the lamp is ionized and electrons are directed towards the anode and positively charged ions are directed towards the cathode. The positively charged ions strike the cathode, leaving the energy they gain to the cathode to heat the cathode. This process is called **sputtering**. Some of the sputtered metal atoms are in an excited state and emit their characteristic (specific) wavelengths as they return to the ground state. Recall that the atoms producing emission lines in the lamp are at a significantly lower temperature and pressure than the analyte atoms in the flame. As a result, the emission lines from the lamp are narrower than the absorption lines in the flame. The sputtered metal atoms eventually diffuse back to the cathode surface or to the walls of the lamp and are deposited.

Hollow-cathode lamps for about 70 elements are available from commercial sources.

The cathode surfaces of the hollow cathode lamps are covered with the element to be analyzed. Therefore, a separate lamp is used for each element analysis. (disadvantage)

However, it has a much longer life than other lamps and is element-specific. (advantage)

2. Super Lamps

The structure is identical to hollow cathode lamps. The difference between them is that the cathode surface in superlamps is coated with 6-12 elements. Determination of 6-12 elements can be performed with the same lamp.

(Advantage)

When determining a single element with these lamps, the lamp life is shortened because all the elements in the cathode are excited. (disadvantage)

3. Xenon Lamps

These are highly intense light lamps that cover the wavelengths of all elements that can be studied in the AAS with a power of 5000-6000 W.

This means that all elements can be studied with a single lamp (**advantage**).

When working with this type of lamps, a second monochromator must be added between the beam source and the atomiser to separate the beam-specific wavelength of the beam at various wavelengths from the beam source. This increases the cost of the instrument (**disadvantage**).

4. Electrodeless discharge lamps

As the name suggests, they do not contain electrodes. A typical electrodeless-discharge lamp is constructed from a sealed quartz tube containing an inert gas, such as argon, at a pressure of a few torr and a small quantity of the analyte metal (or its salt). They work on the principle of ionizing Ar in a quartz tube with an electric arc.

Electrodeless-discharge lamps are available commercially for several elements. They are only particularly useful for elements, such as As, Se, and Te, where hollow-cathode lamp intensities are low.

Atom states are magnetic vector states that arise from the probabilities of the composite state created by unpaired electrons in the orbitals of atoms. This situation, created by the magnetic total compounds of the orbitals called Russell - Saunders interaction, affects the probabilities in atomic transitions. In atomic spectroscopy, the signals are very sharp bands. However, due to some drawbacks, these bands may be slightly expand. These expansions are due to reasons beyond control. There are four factors that cause bandwidth expansion.

These expansions:

- 1- Extensions due to Heisenberg uncertainty principle,
- 2- Doppler extensions,
- 3- Zeemann expansion,
- 4- Pressure expansion

INTERFERENCES IN AAS

Although a light source specific to each atom is used in the AAS, interferences are inevitable in the analyzes.

Initiatives can be grouped under 3 classes:

- **Physical interferences,**
- **Chemical interferences,**
- **Spectral interferences.**

Among these interferences, spectral interferences and chemical interferences are important. These are very common interferences, and are seen in almost every study.