

Atomic Absorption Spectrometry

Hande KAYA

20722904

What Is the Atomic Absorption Spectrometry ?

Atomic absorption methods measure the amount of energy absorbed by the sample.

In 1955 that Alan Walsh, working in Australia, published the first paper demonstrating the use of atomic absorption spectrometry (AAS) as an analytical tool.

It is one of the commonest quantitative instrumental method for analyzing for metals and some metalloids.

About 65 elements can be determined by atomic absorption with sensitivities down to 0.1 mg/mL.

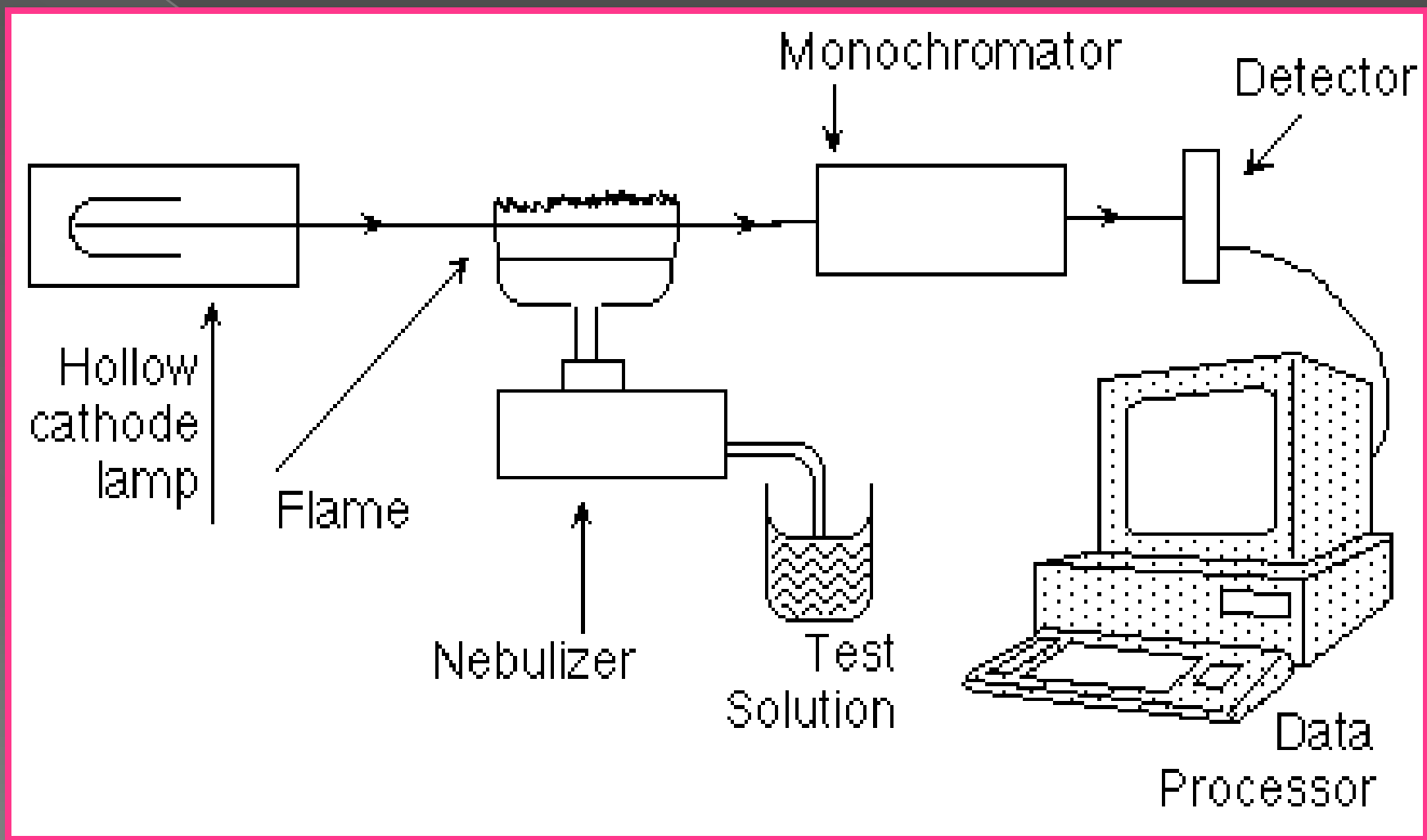
What is the Principle of AAS ?

How It Is Work ?

The process of atomic absorption spectroscopy (AAS) involves two steps:

- ◉ Atomization of the sample
- ◉ The absorption of radiation from a light source by the free atoms

Diagram of AAS



Components for AAS:

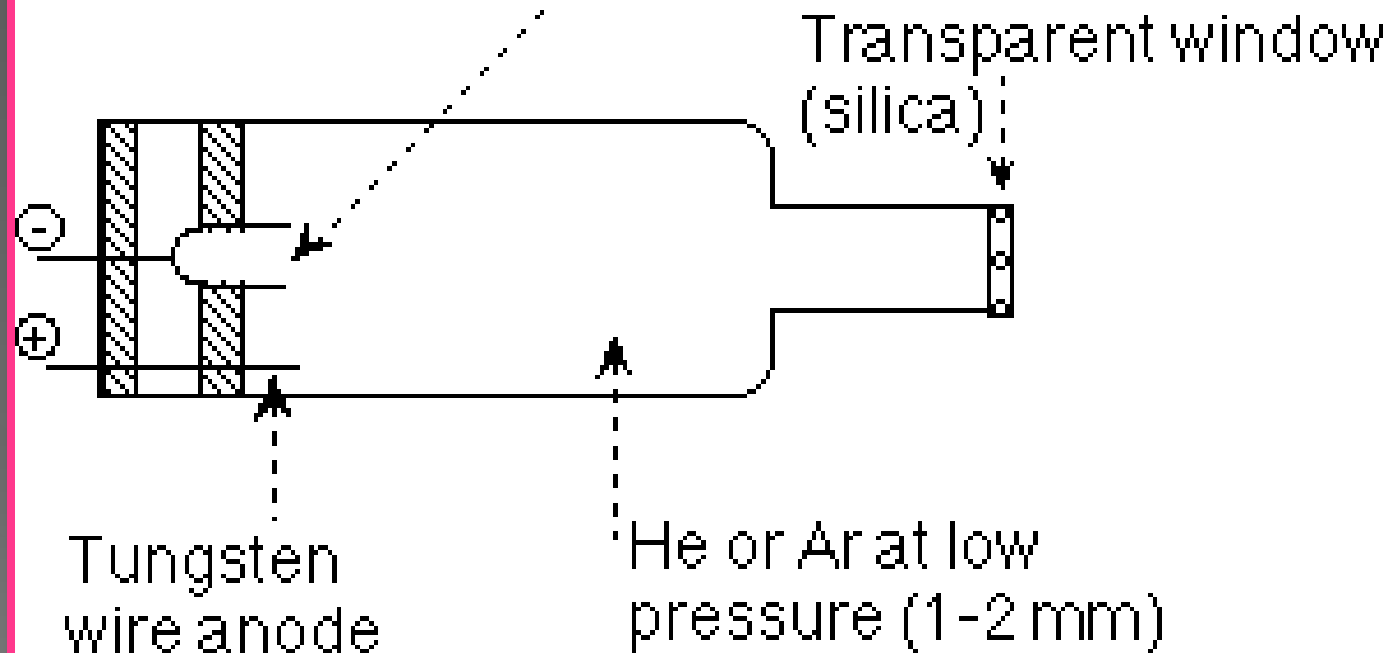
- ◉ Light Source
- ◉ Nebulizer
- ◉ Atomizers
- ◉ Specific Light Measurements
 - Monochromator
 - Detector
 - Amplified
 - Readout - Recorder

Light Sources

Hollow Cathode Lamp (HCL)

- ◉ electric discharge
- ◉ ionization of rare gas atoms
- ◉ acceleration of gas into cathode
- ◉ metal atoms of the cathode are sputtered into gas phase
- ◉ collision of sputtered atoms with gas atoms or electrons
- ◉ excite metal atoms to higher energy levels
- ◉ decay to lower energy levels by emission of light

Hollow cylinder cathode coated
with element same as analyte



Nebulizer

- ◉ *Sucks up liquid sample at a controlled rate*
- ◉ *Creates a fine aerosol for introduction into the flame*
- ◉ *Mixes the aerosol and fuel and oxidant thoroughly for introduction into the flame*
- ◉ *the smaller the size of the droplets produced, the higher the element sensitivity*

Atomizers

Flame Atomizers

- Destroy any analyte ions and breakdown complexes
- Create atoms (the elemental form) of the element of interest

Fuels and Oxidant	Temperature (°C)
Gas/Air	1700-1900
Gas/O ₂	2700-2800
H ₂ /Air	200-2100
H ₂ /O ₂	2500-2700
C ₂ H ₂ /Air	2100-2400
C ₂ H ₂ /O ₂	3050-3150
C ₂ H ₂ /N ₂ O	2600-2800

Flame Atomizers

PRONS

- inexpensive
- high sample throughput
- easy to use
- high precision

CONS

- only solutions can be analysed
- relatively large sample quantities required
- less sensitivity
- problems with refractory elements

Electrothermal Atomizers

- Electrothermal atomization is the technique of choice in case of small sample size.
- It has higher sensitivities than flames.
- Electrothermal atomization should be used when flame methods fail or are difficult to proceed.

Electrothermal Atomizers

○ PRONS

- expensive
- low precision
- low sample throughput
- requires high level of operator skill

○ CONS

- solutions, slurries and solid samples can be analysed.
- much more efficient atomization
- greater sensitivity
- smaller quantities of sample
- provides a reducing environment for easily oxidized elements

Specific Light Measurements

Monochromator

- *Isolate analytical lines' photons passing through the flame*
- *Remove scattered light of other wavelengths from the flame*
- *Only a narrow spectral line impinges on the photo multiplier tube*

Detector

- Photomultiplier Detector

Amplified

Readout – Recorder

- Computer

Applications of AAS

- ◉ water analysis
- ◉ food analysis
- ◉ analysis of animal feedstuffs
- ◉ analysis of additives in lubricating oils and greases
- ◉ analysis of soils
- ◉ clinical analysis

References

- Atomic Absorption Spectrometry. Edited by John Edward Cantle, ELSEVIER SCIENTIFIC PUBLISHING COMPANY, Amsterdam - Oxford - New York 1982
- http://www.nuigalway.ie/chemistry/level2/courses/CH205_atomic_absorption_spectroscopy.pdf
- http://www.chemistry.nmsu.edu/Instrumentation/AAS_Nebulizer.html
- <http://www.files.chem.vt.edu/chemed/spec/atomic/aa.html>
- <http://www.gmu.edu/depts/SRIF/tutorial/aas/aas3.htm>
- [http://www.monzipal.net/Instrumental%20Analysis/Contents/AAS_Part1.htm# Electrothermal Atomizers \(Discrete](http://www.monzipal.net/Instrumental%20Analysis/Contents/AAS_Part1.htm#ElectrothermalAtomizersDiscrete)
- http://weather.nmsu.edu/Teaching_Material/soil698/Student_Reports/Spectroscopy/nebulizer.htm
- http://www.chemistry.nmsu.edu/Instrumentation/AAS_HCL.html
- <http://faculty.plattsburgh.edu/robert.fuller/437web/Lec6AASInterference/index.htm>
- http://faculty.sdmiramar.edu/fgarces/LabMatters/Instruments/AA/AAS_Instrument/AASInstruments.htm
- <http://www.chem.usu.edu/~sbialkow/Classes/565/AA.html>
- http://weather.nmsu.edu/Teaching_Material/soil698/Student_Reports/Spectroscopy/report.htm#introduction