

In-class Questions – Atomic Spectroscopy

Atomization sources:

1. What are the relative advantages and disadvantages of using a flame or furnace as an atomization source?

Instrumental Design Features:

2. If you were to run an analysis using an atomic absorption spectrophotometer, you would note that a separate source lamp called a **hollow cathode lamp** is needed for each individual element that you wish to measure. For example, a lead lamp emits the specific lines of light that are absorbed by lead. Why is the cathode designed with a hollow configuration?

3. Needing a different lamp for each element is expensive and not as simple as using a continuum source with a monochromator. Why is it apparently not feasible to use a broadband continuum source with a monochromator when performing atomic absorption spectroscopy?

4. One thing you might consider is whether continuum lamps have enough power in the part of the electromagnetic spectrum absorbed by elements. In what part of the electromagnetic spectrum do most atoms absorb (or emit) light?

5. Do powerful enough continuum sources exist in this region of the electromagnetic spectrum?

6. A more helpful thing to consider is the width of an atomic line. What are the two major contributions to the broadening of atomic lines? (Hint: We went over these earlier in the course).

7. When these contributions to line broadening are considered, the width of an atomic line is observed to be in the range of 0.002-0.005 nm. Using information about the width of an atomic line, explain why a continuum source will not be suitable for measuring atomic absorption.

8. Why does the hollow cathode lamp have a low pressure instead of a high pressure of argon filler gas?

9. Flame noise (either emission from the flame or changes in the flame background as a sample is introduced) presents a significant interference in atomic methods. Can you design a feature that could be incorporated into an atomic absorption spectrophotometer to account for flame noise?

10. Particulate matter in a flame will scatter light from the hollow cathode lamp. This is a problem since a detector cannot distinguish the difference between light that is scattered and light that is absorbed.

Molecular species in a flame exhibit broadband absorption of light. Again, a detector cannot distinguish broadband absorption from molecular species from absorption by atomic species.

Can you design to feature that could be incorporated into an atomic absorption spectrophotometer than can be used to account for both scattered light and light absorbed by molecular species?

Chemical Interferences

11. Metal complexes with low volatility are often difficult to analyze when performing atomic absorption measurements because the atomization efficiency is reduced to unacceptably low levels. Can you devise a strategy or strategies for eliminating the problem of a non-volatile metal complex?

12. Can you devise a strategy to overcome unwanted ionization of the analyte?

Matrix Effects

13. Devise a general method that can be used to account for the presence of unknown matrix effects.