Name:_____ AES Spectroscopy Lab

Objectives:

- Describe what kind of information can be obtained by Atomic Emission Spectroscopy and how it works
    - Carry out a flame test experiment
    - Examine bright line spectra

Introduction

Atomic Emission Spectroscopy (AES) is an analytical technique that can give insight to what elements are found in a mixture or substance. It does this by examining what wavelengths of light are emitted by the sample and comparing them to the known atomic emission spectrum for each element. To understand these atomic emissions, we must first understand how an atom can emit light.

An the atom, the electrons can be found in the lowest possible energy levels around the nucleus when the atom is in an unexcited or GROUND STATE. The GROUND STATE is a very stable, low energy state, preferred by nature. When energy is added to an atom, the electrons ABSORB this energy allowing the electrons to move up to higher, unoccupied energy levels. This is known as the EXCITED STATE. The EXCITED STATE is at a higher energy than the GROUND STATE and is unstable. In order for the electron to return to the more desirable, lower energy GROUND STATE, the electron must lose the absorbed energy. The electron can give off or emits this energy as visible light, as well as infrared or ultraviolet light. BRIGHT LINE SPECTRA are produced when these electrons in the "EXCITED STATE" fall back to the lower energy level of the GROUND STATE. These electrons EMIT energy which is seen as different color spectral lines which correspond to the energy released. Only certain colors will be present in the BRIGHT LINE SPECTRA depending on the element because of the unique number and energy of that element's electrons. The BRIGHT LINE SPECTRUM is like a "fingerprint" of the element that produced the spectrum. Like a fingerprint, the BRIGHT LINE SPECTRA can be used to identify the element because the bright line spectrum is unique to that element. When viewed with a spectroscope, the individual bands of colors in the BRIGHT LINE SPECTRUM can be seen and the wavelength of each band determined.

Qualitatively, you may be able to determine what elements are present in a sample with a simple flame test; If you excite the atoms with heat and examine what color the flame is, you can identify which element is present. Quantitative data can also be obtained by examining the intensity of the light that is emitted. The more atoms of that element present, the more intense the light is. In this experiment, we will only be determining the qualitative data: we will be identifying the presence of specific elements but NOT their concentrations.

Flame Test Procedure

1. Fill a 250 ml beaker about half-full with distilled or deionized water. Obtain 6 wooden splints that have been soaked in water and palace them in your beaker to continue soaking them at your lab station
2. Fill a second beaker about half-full with tap water. Labe this beaker 'rinse water'. It will be used to extinguish burning wooden splints.
3. Label 6 weighboats "$CaCl_2$", $CuCl_2$, LiCl, NaCl, KCl, $SrCl_2$. Place a SMALL scoopful of each salt in the corresponding weighboat
4. Light the lab burner as demonstrated by the instructor
5. Dip the soaked end of one wooden splint into 1 of the salts, then place it in the flame and observe the color produced. Allow the splint to burn until the color fades, trying not to let any of it fall onto the burner.
6. Immerse the wooden splint in the rinse water to fully extinguish it.
7. Record your observations in the data table and repeat the steps for each of the salts including the one unknown.

Color	Wavelength (nm)
Violet	410
Blue	470
Blue-green	490
Green	520
Yellow-green	565
Yellow	580
Orange	600
Red	650

Metallic Solid	Color	Wavelength
Unknown		

Flame Test Questions

1. Why do you think its important that all of the metallic solids used have Cl^{-1} as the anion? Why couldn't you use NaCl and LiBr to make your comparisons?

2. What kind of information are you able to determine by doing this experiment; qualitative or quantitative. Explain.

3. What is the identity of the unknown metallic solid? How were you able to make this determination?

Bright Line Spectrum Procedure

- HOW TO USE THE SPECTROSCOPE
    1. The narrow end of the spectroscope is the part that you will hold to your eye.
    2. On the other end, there is a narrow slit that will be where the light you are analyzing will come into the spectroscope.
    3. Look through the spectroscope and examine the bright lines that are visible off to the side. There is a numbered grid that represents the wavelength of that light. If its on the 6, thats 600nm.
    4. When looking at the discharge tubes that only have 1 element in them, **draw ONLY the bright lines**. There may some background color which you SHOULD NOT DRAW.
- Lab Procedure
    1. Use the spectroscope to examine the light that comes from the sun and draw what you see on the data table
        a. **NOTE: DO NOT STARE DIRECTLY INTO THE SUN**. Point it at any semi-bright part of the sky. Even on a cloudy day this shouldn't be an issue.
    2. Do the same thing with the lights for the room. These lights are likely LED lights. Draw what you see.
    3. Use the spectroscopes to examine the gas discharge tube who's identity is known
        a. ONLY TURN ON THE TUBE FOR 30 SECONDS AT A TIME with 30 seconds of it being turned off in between each trial.
    4. Do your best to line up the slit of your spectroscope with the narrow part of the tube.
    5. Draw **ONLY THE BRIGHT LINES** that you see on your data table. Also make note of the color of the thin part of the tube, as observed without the spectroscope.
    6. Do the same for the unknown discharge tube and use the Spectrum Chart to determine its identity

Sunlight

400 nm	500 nm	600 nm	700 nm

Room Lights

400 nm	500 nm	600 nm	700 nm

Element:_____ **Color of thin part of tube:_____**

400 nm	500 nm	600 nm	700 nm

Unknown Element: **Color of thin part of tube:_____**

400 nm	500 nm	600 nm	700 nm

BLS Questions

1. Why do you think the sunlight doesn't give distinct bright lines like the discharge tubes do?

2. What did you determine the identity of the unknown element to be?

3. Describe how the bright lines are produced

4. Why is it that each element will produce unique bright line ‘fingerprints’?

5. If the concentration of the gas in the discharge tubes was increased, what would happen to the bright lines you observed?