Lab 7: Emission Spectra

Purpose

To observe the emission spectra of different gasses and to identify each gas based on its characteristic spectrum.

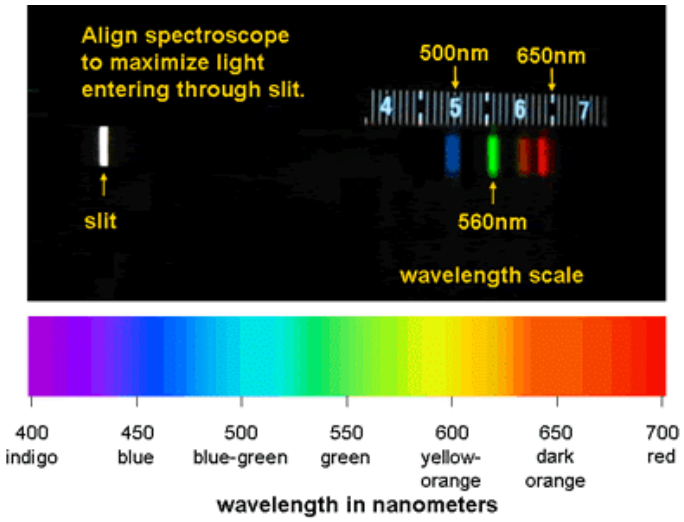
Introduction

The spectra of chemical elements are like atomic fingerprints, each element's emission spectrum is unique and can be used to identify the elements in matter of unknown composition. The emission spectrum of a chemical element (or molecule) is the spectrum of frequencies of electromagnetic radiation emitted due to the electrons in the atoms transitioning from a high energy states to lower energy states. The energy of the emitted photons is equal to the energy difference between the two states. There are many possible electron transitions for each atom, and each transition has a specific energy difference. This collection of different transitions, leading to different radiated wavelengths, make up an emission spectrum.

Spectroscopy is the analysis of the spectrum of a given substance in order to tell its composition. In this lab you will do some basic spectroscopy in order to tell which element is producing the light of a lamp.

Procedure

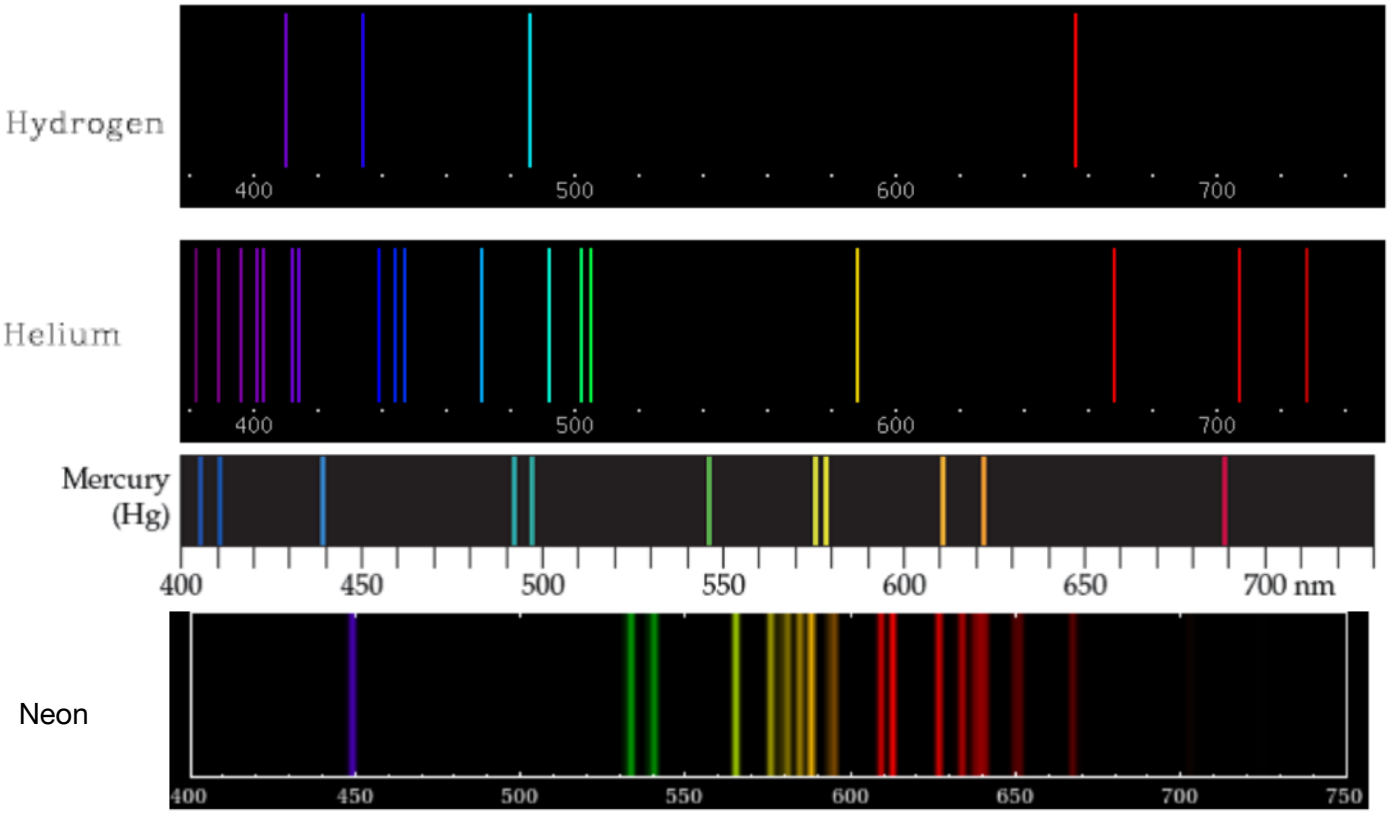
1. Aim the slit of the spectroscope to the light coming from the emission tube. It works best if the slit is oriented parallel the length of the emission tube in order to maximize the light entering through the slit.
2. Observe the emission lines landing on the labeled scale. If you see emission lines outside the labeled scale ignore them, they are the secondary spectrum containing the same information.



3. Compare what you see with the provided known spectra from different elements and identify which elements are you looking at.

The known visible spectra of Hydrogen, Helium, Mercury and Neon

Use the following list of known spectra to identify the elements in the different gas tubes.



Analysis

Tube #1

1. Sketch the spectrum you see labeling the approximate wavelength and color of each line. You don't have to draw all of the lines, just enough so you can identify this element (the 3-5 brightest lines should be enough).

2. Which element is in this tube

3. Calculate the energy of the photons producing the brightest line in the spectrum of this element?

$$E = hf = h\frac{c}{\lambda}$$
$$h = 4.14 \times 10^{-15} eV \cdot s$$
$$c = 3 \times 10^{8}\ m/s$$

Tube #2

1. Sketch the spectrum you see labeling the approximate wavelength and color of each line. You don't have to draw all of the lines, just enough so you can identify this element (the 3-5 brightest lines should be enough).

2. Which element is in this tube?

3. Calculate the energy of the photons producing the brightest line in the spectrum of this element?

$$E = hf = h\frac{c}{\lambda}$$
$$h = 4.14 \times 10^{-15} eV \cdot s$$
$$c = 3 \times 10^{8}\ m/s$$

Tube #3

1. Sketch the spectrum you see labeling the approximate wavelength and color of each line. You don't have to draw all of the lines, just enough so you can identify this element (the 3-5 brightest lines should be enough).

2. Which element is in this tube?

3. Calculate the energy of the photons producing the brightest line in the spectrum of this element?

$$E = hf = h\frac{c}{\lambda}$$
$$h = 4.14 \times 10^{-15} eV \cdot s$$
$$c = 3 \times 10^{8}\ m/s$$

Tube #4

1. Sketch the spectrum you see labeling the approximate wavelength and color of each line. You don't have to draw all of the lines, just enough so you can identify this element (the 3-5 brightest lines should be enough).

2. Which element is in this tube?

3. Calculate the energy of the photons producing the brightest line in the spectrum of this element?

$$E = hf = h\frac{c}{\lambda}$$
$$h = 4.14 \times 10^{-15} eV \cdot s$$
$$c = 3 \times 10^{8}\ m/s$$