Spectroscopy Analysis of Emission of Gases and Various light sources

Objective :

1. Determine the emission Spectrum of Various known gases from given gas discharge tubes.

SAFETY

Wear safety glasses throughout this activity. The devices used in this experiment to power the gas- filled tubes use a very high voltage of electricity. Do not remove the gas-filled tubes or insert metal objects such as pens or paper clips into the power devices. The gas-filled tubes will be very hot to the touch, so be careful to not touch the surfaces.

INTRODUCTION

Atomic spectroscopy is an extremely important tool for scientists. Because the electron patterns around every kind of atom are unique, and because these electrons interact with light in different ways because of their different positions, you can determine what kinds of atoms are present in a substance by the kind of light absorbed or emitted by the substance. Every atom has a kind of "fingerprint" in the normal light spectrum that is measured with a device called a Spectrometer. This instrument uses a diffraction grating as a prism, splitting the incoming light into its composite colors.

As an example, a marine ecologist may suspect that the reason many bottom-dwelling organisms are dying in a local harbor is because of a chemical pollutant. She samples the mud and chemically extracts a type of metal ion, but she's not sure what kind of metal it is. She injects the metal ions into the hot flame of an atomic emission spectrometer and observes two line spectra. The lines correspond to the wavelengths of 563 nanometers (nm) and 615 nm. This combination is the "fingerprint" for tin. The ecologist may then trace the tin to a particular type of ship's paint or a nearby industrial source.

The energy – level model assumes that electrons can orbit the nucleus only at certain fixed distances from the nucleus. These are called energy levels. The energy levels of an electron depends on its distance from the nucleus. The closer the electron is to the nucleus, the less the energy it has. The farther the electron from the nucleus, the more energy it has. The model proposes that there are many imaginary spheres of increasing radius, with the nucleus at the center. These spheres represent different energy levels.

An electron goes to a higher energy level when energy is added to it. An electron that

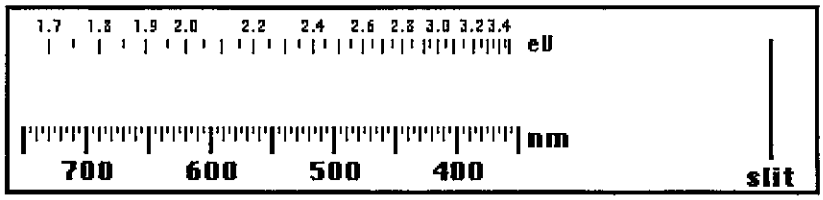
has energy added to it is in its excited state, and it will jump to a higher energy level farther from the nucleus. The electron can return to its original ground state in steps. Upon returning to its ground state it can emit various forms of energy in the electromagnetic spectrum (photons). The energy in the visible region can be observed using the spectroscopy equipment provided.

In this lab, you have a little bit easier task than separating metal ions from sea mud. You are observing various light sources including tubes that have been filled with various types of gases. As electricity passes through these tubes, the gas glows and light is given off. You will compare the spectra of these gas tubes with incandescent (regular light bulb) sources and fluorescent light fixtures. Specifically, you will be asked to identify the gas that is used to fill fluorescent light tubes.

PROCEDURE

A. Listen to your teacher's directions on how to use and care for the Spectrometer. These instruments are expensive and fragile, so make certain that you understand the rules for their use.
B. Rotate with your lab partner through the various observation stations. Use the Spectrometer placed at each station to take your measurements. Everyone will start at different stations and move through the lab to complete their observations in the time established by the teacher. When observing the light from a gas tube, make sure that the center of the glowing spectrum tube is very close to and directly in front of the spectrometer slit (CAUTION: Do not touch the gas tubes because they are hot and may give you an electrical shock!).

1. Sun light
   Sketch what you see on the diagram below, marking the wavelengths that define each colored region. Also, mark the limits of your visual range on both ends of the spectrum. Sketch the range of colors observed using the colored pencils, and note the regions where the colors are most bright and most dim.



QUESTIONS

1. Helium was discovered in the Sun's corona during the eclipse of 1868. In 1888, traces of helium were isolated here on Earth. How could scientists determine that this was the same gas that had been identified on the Sun?
2. Compare the results of the various gas tube spectra with the spectrum observed using the standard fluorescent light tube. Based on your results, what gas do you think is used in fluorescent light tubes?
3. Was there any difference between the spectra of the standard fluorescent light tube and the compact fluorescent light fixture? Why do you think this is so?
4. Compare the results of the incandescent light bulb with the spectra of the fluorescent light tube and the compact fluorescent light fixture. Based on the observed spectra, can you think of a reason why the fluorescent lights are considered as more "energy efficient"? Could there be a disadvantage to this?
5. Now that you know more about what gases are contained in fluorescent lights, why do you think there is a concern about the breakage and improper disposal of these tubes?
6. What colors dominated the spectrum of the "Plant Grow" light? How was this different from the regular light bulb? Can you think of a reason why this light might be better for plants (hint: plants are usually green...)?

Repeat this activity online at http://boyles.sdsmt.edu/emmislgt/emmis.htm

Answer the questions found at the following Website http://boyles.sdsmt.edu/emmislgt/emmis.htm