Flame Tests

Purpose

1. To observe the characteristic colors imparted to a burner flame by several metal ions.
2. To determine the metal ion present in an unknown salt.
3. To observe the atomic spectra of some metal atoms using a spectroscope.

Introduction

The heat of a burner flame supplies sufficient energy to excite the electrons of many elements from their ground state, to a higher energy state. These higher energy states are unstable; as the excited electrons drop back to their lower energy ground state, they emit energy in the form of visible light. Since the electron energy levels of each element are unique, the energies of light emitted in transitions from a higher, excited state to the ground state are unique, and can be used to identify an unknown element. For some combinations of elements, the colors emitted when heated in a flame are indistinguishable to the eye; a spectrometer must be used to obtain spectra, which are distinguishable.

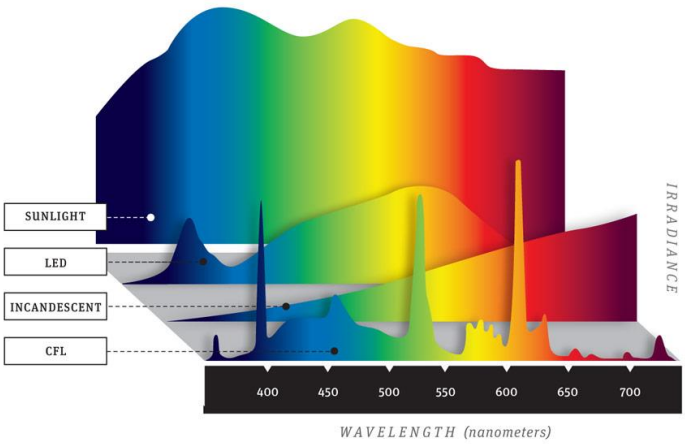
Equipment

- Safety goggles
- Spectroscope
- Alcohol or butane burner and igniter
- Small beakers for salts
- Salts of lithium, sodium, potassium, calcium, strontium, and copper
- Inoculating loops

Procedure

Part I. Using the Spectroscope

Practice using the spectroscope by looking at various lights – incandescent, fluorescent, LED and sunlight. Write down your observations from all light types in the table below. Incandescent bulbs use halogen gas (iodine, bromine), and fluorescent bulbs use mercury gas. Adjust the spectroscope until the spectrum is horizontal and clear.



Part II. Observing the metal salts

A. Put on safety goggles. Ignite the burner, and adjust until a blue, nearly invisible flame is observed.

B. Observing the salts

1. Dip a loop of wire into water first, then into a prepared sample of solid sodium chloride. Using tongs, hold the loop in the flame and observe the overall color of the flame and record in Table 2.
2. Take care not to destroy or melt the inoculating loop.
3. Repeat Steps 1 through 3 for lithium, potassium, calcium, strontium and copper, making sure you use a different inoculating loop for each salt, and holding only with tongs.
4. Using tongs, extinguish the alcohol burner by placing the cap over the flame. Do not touch the cap for at least 10 minutes, it is hot! If using the butane burner, turn the burner off.
5. Clean up your lab area, throw the inoculating loops away.

Report Sheet

Table 1. Observations with the Spectroscope

Light Source	Wavelengths observed (if any), intensity, and other observations
Incandescent	
Fluorescent	
Sunlight	

Table 2. Flame Colors

Metal Salt	Flame Color	Metal Salt	Flame Color
Sodium Chloride		Lithium Chloride	
Calcium Chloride		Strontium Chloride	
Potassium Chloride		Copper Sulfate	

Questions:

1. Why do you use a different inoculating loop for each sample?

2. What accounts for the different flame colors?

3. What did you notice about the intensity (or irradiance) pattern of LED lights? Do the readings you obtained match the chart?

4. Why do you think the spectral line pattern looks different for the fluorescent lights verses the incandescent light?

5. When comparing spectral lines from sunlight verses the incandescent bulbs, what do you notice is similar about each? What is different?