

The Chemistry of Lighting

The famous, flashing neon lights of Times Square and Las Vegas shine because of electron orbitals. These lights contain neon gas or other gases at low pressure. When electric current passes through the gas, the atoms absorb some of the electrical energy, causing some of their electrons to move to higher orbitals. While dropping back to lower orbitals, the electrons give off the energy in the form of light. The color of the light is characteristic of the gas in the tube. Figure 12.5 shows some of these colors. Helium produces a yellowish light, and argon produces lavender. Krypton gives a whitish light, xenon gives blue, and neon shines orange-red. By combining neon with other gases, other colors can be obtained. Sodium and mercury vapor lamps work in a similar way except that these metals must first be vaporized.

The light bulbs used in most homes are incandescent lamps. Their light is produced by a white-hot tungsten wire heated by an electric current. At such high temperatures the tungsten atoms give off white light much like sunlight. White light is really a combination of all the colors. This type of light is given off by hot solids and liquids and even by dense gases. The tungsten filament would rapidly burn up in the presence of oxygen. To prevent this, an incandescent bulb is filled with argon or nitrogen.

Fluorescent lighting is much more efficient than incandescent lighting because no hot filament is involved. The long glass tube of a typical fluorescent bulb contains small amounts of mercury vapor and argon gas. The inside of the bulb is coated with a powder called a phosphor. When current passes through the bulb, electrons in the mercury atoms are excited to higher energy levels. In dropping back to the ground state, they emit ultraviolet (UV) light, which is not visible. The UV light is absorbed by the electrons in the molecules of the phosphor coating of the tube. When the phosphor electrons return to their ground state, they emit visible white light. A 40-watt fluorescent bulb produces as much light as a 150-watt incandescent bulb. It is no wonder that more than 75% of the lighting used in North America is fluorescent.

Think About It

6. Appraise Which of these gives the most “natural” light: tungsten-filament bulb, fluorescent lamp, or neon light? Why?

7. Explain Why would an energy-conscious consumer choose fluorescent lighting over incandescent lighting?

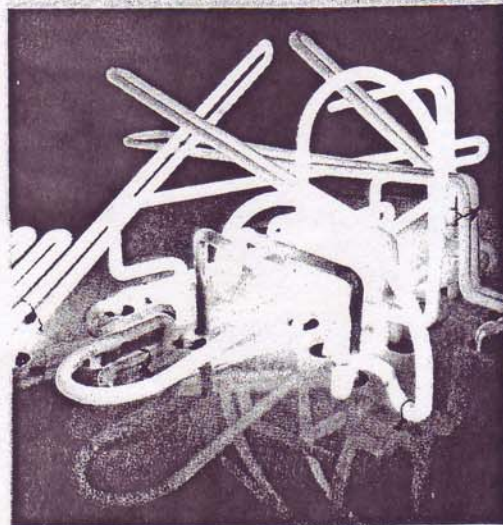


Figure 12.5 Noble gases give off light of characteristic colors.



Figure 12.6 Sodium vapor lamps produce a bright yellowish light. Sodium vapor lamps are used where energy efficiency and low maintenance are more important than realistic color.