Fluorescent Fiber Kit

Instruction Manual

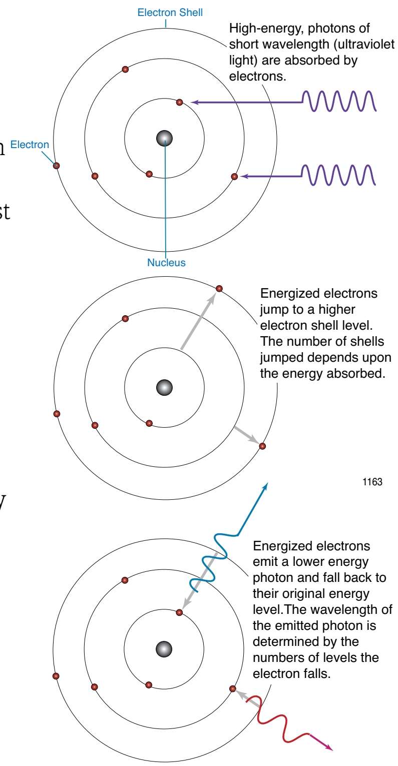
Demonstrate the phenomenon of fluorescence quickly and easily with optical fiber.

Model Number:
IF 567

INDUSTRIAL FIBER OPTICS

INTRODUCTION

Atoms, the basic building block of matter, consist of a small and dense center (nucleus) surrounded by electrons — the same particles that produce electric currents. Electrons circle the nucleus in different orbits, or distances from the nucleus. The farther they are from the nucleus, the more energy they possess. Think of each electron as a car traveling in a circle. The larger the circle the faster the car can go without losing control on tight curves.



When electrons pick up sufficient additional energy from an outside source, they must jump to the next outer orbit or energy level (think of the car traveling in a larger circle). Conversely, when an electron moves from an outer orbit to an inner one, it must give up energy. This energy is released as a particle of light called a photon. Most atoms contain many electrons at many different energy levels (orbits). The color of light that each electron will produce depends on how much energy it loses if it falls from one orbit to an inner one. The electrons in different materials have specific and predictable reactions when they are stimulated by an outside energy source and move between energy levels. They have a characteristic color or colors that can be repeatedly produced by outside energy stimulation. These characteristic colors are associated only with that particular material.

Fluorescence is defined as the emission of light when a material is bombarded by high-energy particles or photons. In this experiment the high-energy source is blue or ultraviolet light that you may not even see with your eyes. However, with this kit you will use specially treated plastic material fabricated into optical fibers so you can plainly observe fluorescence in action.

KIT CONTENTS:

- Red-colored 1 mm (.04 inch) diameter optical fiber*
- Green-colored 1 mm (.04 inch) diameter optical fiber*
- Clear 1 mm (.04 inch) diameter optical fiber*
- 3 mm (1/8 inch) black tubing, 15 cm (6 inches) long
- Instruction sheet

* Other fiber diameters may be substituted for the 1 mm fluorescent fiber.

FOLLOW THESE STEPS:

- Lay the green, red and clear fibers on a table. Observe their brightness and color from all sides and angles. Do any of the fiber ends have different visual characteristics than the sides?
- How do the colored fluorescent fibers compare to the clear fiber?
- Find a room that you can completely darken. With the lights off and window coverings closed, do the green and red fibers continue to glow ("fluoresce")?
- Turn the room lights back on and open window coverings. Insert one end of the red fiber inside the heat shrink tubing and slide the fiber slowly further into it while observing the exposed fiber end. How does the brightness of the exposed fiber end change as the fiber slides into the black tubing? Repeat with the green fiber.
- Now slowly insert the clear optical fiber into the black tubing and observe any light that appears out of the exposed end of this fiber.

RESULTS:

The center portion (core) of both colored fibers appears to glow, as if the fibers were producing red or green light. The fiber sides are uniform in color, but dull. As the room light diminishes, the glow from the fiber ends decreases. In a totally dark room the fiber stops glowing completely. As fibers are inserted into the black tubing, the glow from the exposed end does not change at first. When the fiber exposed from the tubing is 5 cm (2 inches) or less, the brightness at the fiber end begins to decrease. When black walls completely surround the fiber, its tip will be very dim. There should be little or no light observed coming from the end of the clear fiber.

WHY:

With this special colored fiber material, atoms absorb high-energy light of one color, and almost immediately release the energy as light of another color. Many substances fluoresce when ultraviolet light strikes them. We cannot see ultraviolet, but we can see the lower-energy light that fluorescence produces.

The red- and green-colored fibers contain a central core that includes a material with fluorescent properties. The fluorescent core absorbs blue and ultraviolet light from all directions. It then re-radiates the energy in the form of red or green light (depending on the material in its core). The cladding on the outside of the fiber core traps the radiated light and guides it toward the ends, which is why they glow and the sides do not.

APPLICATIONS:

These types of fibers are often used in radiation protection and measuring devices. The fluorescent material absorbs high-energy alpha, beta and gamma radiation and converts that energy into forms that can be measured by conventional visible light detectors.

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Printed in the United States of America

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