

# **THE MICROSCOPIC WORLD: A DEMONSTRATION OF ELECTRON MICROSCOPY FOR YOUNGER STUDENTS**

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KEY WORDS: Microscope, Scanning Electron Microscope, high magnification, scientific method

PREREQUISITE KNOWLEDGE: This demonstration is specifically designed for elementary school students. The level can be easily adjusted for more advanced students with the same basic presentation.

OBJECTIVES: The purpose of this demonstration is to excite the students about the importance of scientific investigation and why they should look at the things in greater detail, extending beyond superficial examinations.

EQUIPMENT AND SUPPLIES: The demonstration requires 35 mm slides of photographs (micrographs) of various objects taken with a wide range of magnifications. In addition, a simple object, such as a baseball, needs to be prepared as an initial focus of what can be learned from looking at an object compared to what we can learn by taking it apart and looking at it at high magnifications.

PROCEDURE: The focus of much of the demonstration is a slide show of electron micrographs of various things from the world around the students. In order to demonstrate the investigative nature of science, a baseball is used as an example. First, the baseball is described by the students as they see it and use it (color, texture, "bouncing", etc.) Then, the students are asked to examine a baseball that has been cut in half. Now, the students can see that the ball is composed of several different materials.

After the above introduction, a slide presentation begins with high magnification micrographs of the various components of the baseball. Following the baseball micrographs, slides of other common items are shown and discussed relative to the function of the item. These range from butterflies and sequins to rocks and broken pencils. Figures 1 and 2 show examples of micrographs of a butterfly wing and a broken pencil. For older students, these simple concepts can be extended to a discussion of advanced ceramics, the materials used, for example, as space shuttle tiles and high temperature superconductors. The toughening of advanced ceramics is largely accomplished by the introduction of microscopic fibers and secondary phases. Micrographs show the scale of these reinforcing materials (compared to a human hair, for example, as shown in Figure 3). In addition, the importance of the atomic scale in the processing of modern materials is emphasized.

The most important aspect of this demonstration is the narrative that accompanies the slides. Magnifications must be discussed in terms that the students can understand. For example, stating that the picture is a 400X magnification is not sufficient; the students can much better relate to "this is a picture of what a butterfly wing would look like if a 2 inch butterfly were enlarged to over 60 feet across!" It is equally important that items be photographed that are of interest to the students. The demonstration to be presented during the workshop is made-up of items gathered by a first grade class.

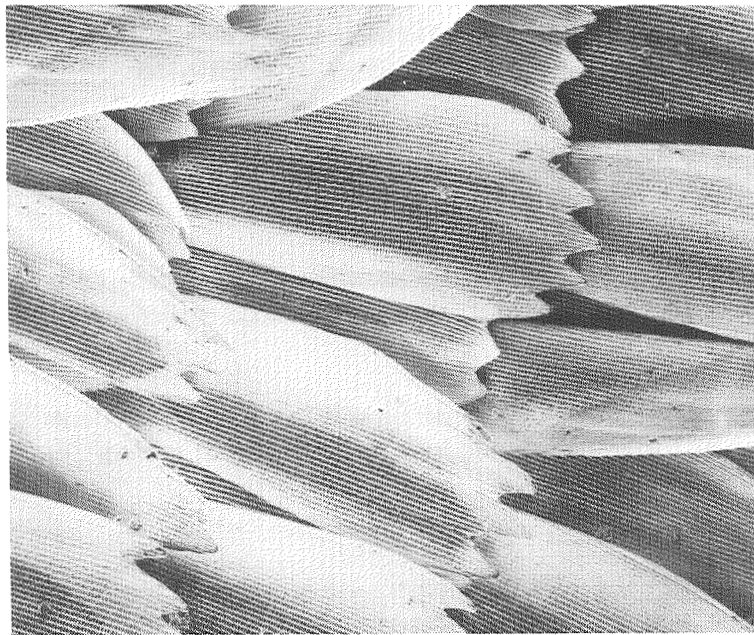


Figure 1: 700 X scanning electron micrograph of a butterfly wing. At this enlargement, a 2 inch butterfly would be over 60 feet across.

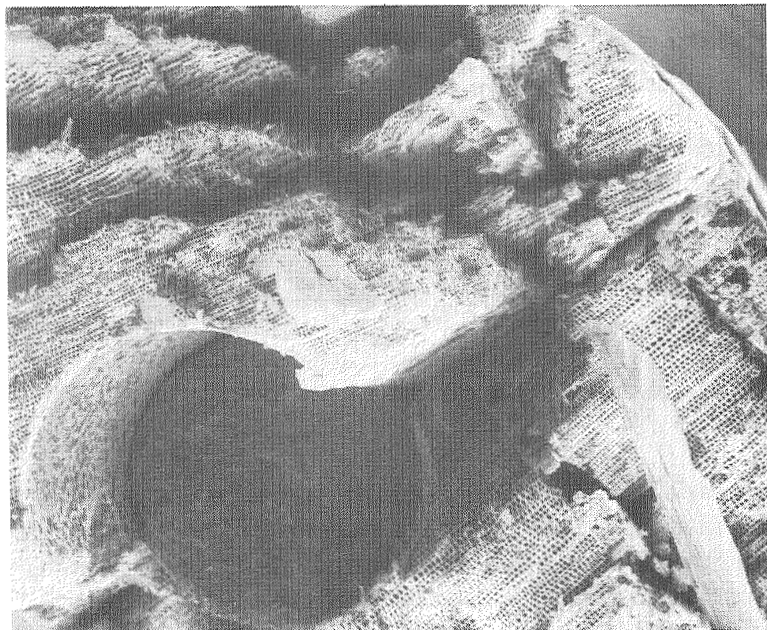


Figure 2: 20X scanning electron micrograph of a broken pencil. At this enlargement, a standard pencil would be over 5 inches wide.

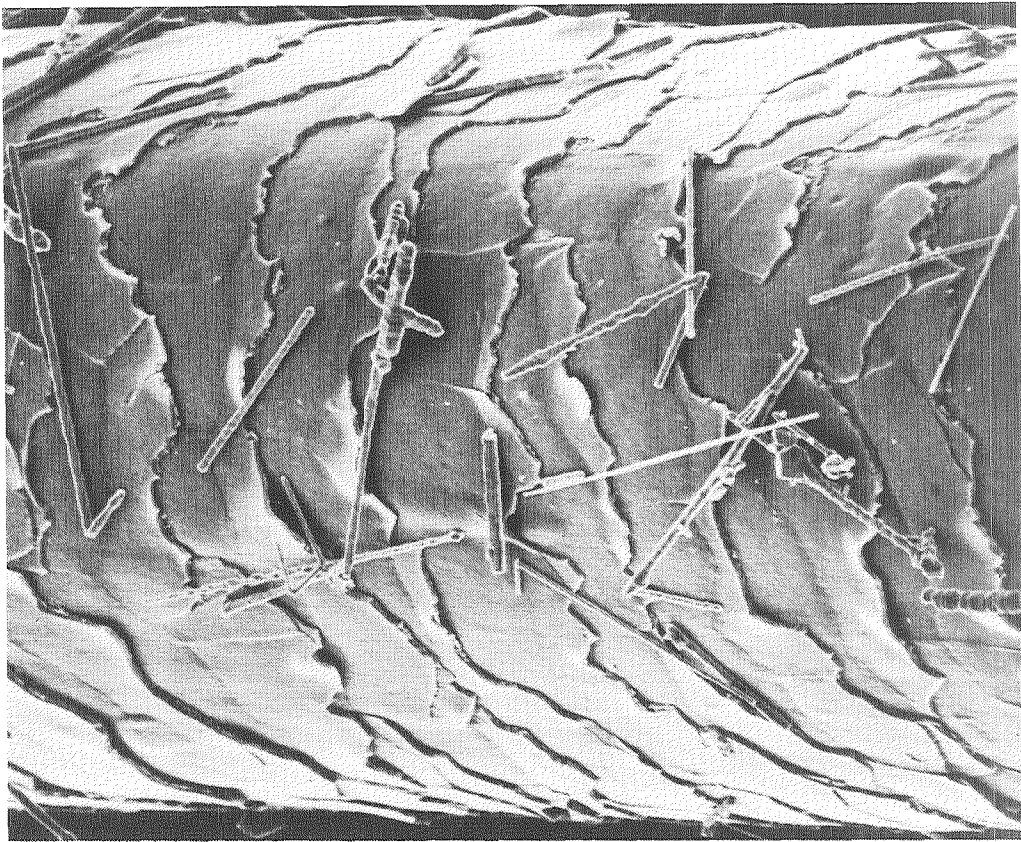


Figure 3: 2,000X scanning electron micrograph of a human hair with silicon carbide fibers deposited on it (small fibers are silicon carbide, large scale object is the hair). Silicon carbide fibers are used as reinforcements to make ceramics stronger.

**INSTRUCTOR NOTES:** This demonstration is probably one that will need to be solicited from a facility with trained microscopists and access to scanning electron microscopes. The classroom teacher and the scientist can "team" to ensure the appropriate level discussion of the material and relevance of the objects presented relative to current classroom science curriculum. This approach provides the additional benefit of the involvement of a practicing scientist in the classroom.

**SOURCES OF SUPPLIES:** For information about the availability of an ORNL speaker or about possible microscopists in your area, please contact Dr. Linda L. Horton, Building 4500S, MS 6118, Oak Ridge National Laboratory, P. O. Box 2008, Oak Ridge, TN 37831-6118, Telephone: (615) 574-5081.

**Acknowledgement:** Research sponsored by the Division of Materials Sciences, U.S. Department of Energy, under contract DE-AC05-84OR21400 with Martin Marietta Energy Systems, Inc.