Department of Commerce
Malcolm Baldrige
Secretary

National Bureau of Standards
Ernest Ambler, Director

National Bureau of Standards

Certificate

Standard Reference Material 2069

SEM Performance Standard

This Standard Reference Material (SRM) is intended for use in evaluating the performance of scanning electron microscopes (SEM). One edge of a single fiber is used as a clearly defined boundary across which the electron beam is scanned (1). The slope of the resultant waveform is a measure of the SEM performance that can be related to the resolution capability of the SEM. The procedure to be followed in determining SEM performance is given on the back of this certificate.

The carbon fibers in this SRM have surfaces that are very smooth and uniform. Substructures were not found in transmission electron microscopic studies of microtomed cross-sections and the fibers are relatively free of debris. Two lengths of fiber bundles are attached to an SEM specimen mount that has a recessed central area machined into it. The fibers protrude over the recessed area and are held in place with carbon cement. This mounting provides a low background signal.

Additional fibers are provided in a glassine envelope so that they can be mounted by the user to meet special requirements.

The carbon fibers, designated as T-80, are natural fibers that had been graphitized and donated to NBS by C. J. Leistner of Ultra Carbon Corp., Bay City, Michigan.

The work leading to the certification of this SRM was performed by D. B. Ballard of M. E. Taylor Engineering, Rockville, Maryland.

The support aspects concerning the certification and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by R. Keith Kirby.

November 29, 1983
Washington, DC 20234

Stanley D. Rasberry, Chief
Office of Standard Reference Materials

(Over)

Performance Test Procedure

Several blasts of clean air will usually spread the fiber bundle so that a single fiber can be selected. Additional spreading may be necessary and can be accomplished by using a clean probe such as a needle. The specimen mount should be held rigidly in place in the SEM to prevent vibration. A clean vacuum of $1.3.10^{-2}$ Pa or better is needed to minimize specimen surface contamination which will effect the waveform slope. The mount should be tilted and rotated so that the electron beam scans across a single fiber in a direction perpendicular to the fiber edge. A microphotograph of the fiber should be made to verify edge position and quality.

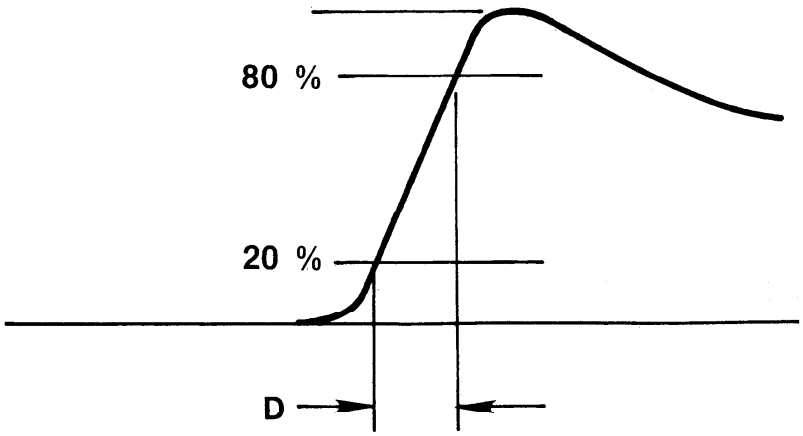
Select a high SEM magnification so that when the beam scans across a fiber edge, the waveform (display of the transition from black to white) will have a sufficiently large horizontal displacement (see Fig 1 and paragraph below for details). Since slow scans or stationary high brightness waveforms damage the CRT screen, the recorded waveform should be made within two seconds.

On the recorded waveform (an illustration is given in Fig. 1) measure the difference between the minimum and maximum signal levels. Using this value, compute the positions on the Y axis that correspond to 20% and 80% signal levels. Locate these positions on the waveform and measure the horizontal distance, D, between them (in mm). If the value of D is at least 3 mm then the performance, P, in nanometers can be computed from

$$P = \frac{Dx10^6}{M}$$

where M is the magnification of the SEM. An average of three measurements from different edge positions should be used as representing the performance of the SEM at that magnification and instrument settings.

Figure 1



Reference

(1) Sputter Coated Carbon Specimens for SEM Performance Testing, D. R. Black and D. B. Ballard, 1982 EMSA Annual Proceedings, page 750.