

National Bureau of Standards

Certificate

Standard Reference Material 2069a

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 detector signal 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 and additional details are given in ASTM E986.

The carbon fibers in this SRM have surfaces that are very smooth, uniform, and relatively free of debris. Transmission electron microscopic studies of microtomed fiber cross-sections show rounded edges. Two different lengths of fiber bundles are attached to an SEM specimen mount that has a recessed central area machined into it. One end of the fiber bundle protrudes over the recessed area and is held in place with carbon cement. This mounting technique 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 graphitized carbon fibers were 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, Inc. Wheaton, Maryland.

The support aspects concerning the certification and issuance of this Standard Reference Material were coordinated through the Office of Standard Reference Materials by L.J. Kieffer.

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Stanley D. Rasberry, Chief
Office of Standard Reference Materials

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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 $1.3 \cdot 10^{-2}$ Pa or better is needed to minimize specimen surface contamination which will affect 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.

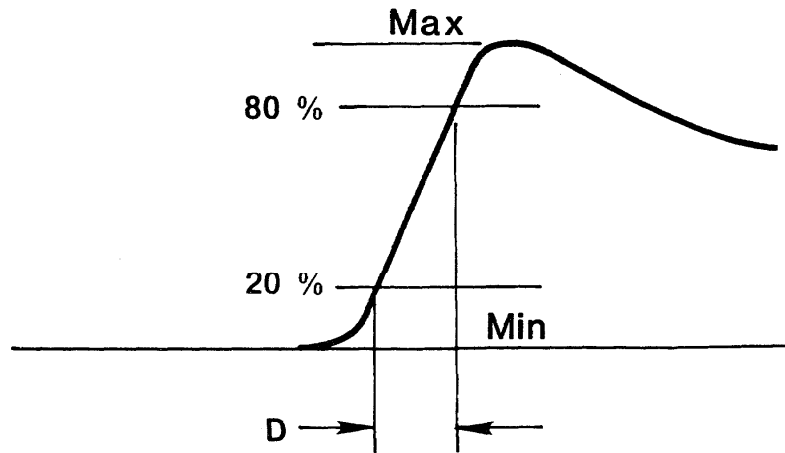
Select a high SEM magnification so that when the beam scans across a fiber edge, the waveform (display of the transition from black to white) will have a sufficiently large horizontal displacement (see Fig 1 and paragraph below for details). Since slow scans or stationary high brightness waveforms damage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

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% of maximum signal levels. Locate these positions on the waveform and measure the horizontal distance, D, between them (in mm). The distance, D, should range between 2 to 4 mm. The performance, P, in nanometers can then be computed from

$$P = \frac{D \times 10^6}{M}$$

where M is the magnification of the SEM. An average of three measurements from different fiber 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.