## SCANNING ELECTRON MICROSCOPE (SEM)

### Introduction

The Scanning Electron Microscope (SEM) allows visualization of surface features of a solid sample by scanning through an electron beam. A beam of electrons is produced from a tungsten filament by thermionic emission, which is accelerated in a high vacuum towards an anode. The emerging electron beam is focused and scanned over the sample surface using magnetic lenses. This beam of the electron is called primary electrons. Electrons of the primary beam interact with the matter of the sample. Interaction provides a variety of signals such as secondary electrons (SE), elastically scattered backscattered electrons (BSE), and X-rays. These are used for various purposes, such as:

**(a) Secondary electrons (SE):** Surface morphology (features)

**(b) Backscattered electrons (BSE):** Composition contrast and surface topography

**(c) Energy dispersive X-ray (EDX) detector:** Elemental composition and mapping analysis

BTRA has an advanced JEOL JSM IT 200 LV SEM machine equipped with EDS (Energy-dispersive X-ray) detector. The surface and cross-sectional morphology of the sample can be magnified from 10× to 3,00,000× and has the lowest resolution of about 10 nm over the 0.1 to 30 kV acceeelerating voltage. The online dimensional measurement facility is available with this machine.

**Samples from textile, metal, ceramic, pharmaceutical, polymer, civil, electrical and electronics, and other allied industries, can be tested on this SEM machine.**

**Figure: Scanning electron microscope JEL JSM IT 200 LV at BTRA**

## Frequently asked questions

### 1) What is surface morphology?

It is about the shape, size, textures, and features on the sample surface.

### 2) What types of samples can be analyzed?

A wide range of materials whose morphology can be routinely analyzed include :

- Metals, Glass, Ceramics, and Polymers
- Semiconductors
- Plastics
- Fibers (Natural and synthetic)
- Powders and Dust
- Pharmaceutical powder, pellets, capsules

### 3) How is the sample prepared for SEM-EDX analysis?

The supplied sample is first mounted on double-sided carbon tape. For our SEM, the conventional sample holder size is 2.5 cm × 2 cm (rectangular) and has a diameter of 1 cm (round). So, the size of the mounted sample is limited by that dimension. Before a sample to be observed under the SEM, it is often necessary to carry out a gold coating to make the sample conductive. For conductive samples like metals, a coating step is not required.

### 4) Will coating destroys the sample surface morphology?

The gold coating is too thin to hide the sample morphology, so it does not destroy the surface morphology of the sample.

### 5) Can our suspension be analyzed?

Samples that contain volatile liquids and dryable can be analyzed.

### 6) Can SEM give quantitative information?

SEM provides micrographs with scales that can be used to get quantitative information like the distance between two points on the micrograph. It can also be used to find the size, aspect ratio, pore size and density, and shape of a feature. But, it does not provide topographical height information as AFM does.

### 7) Can we analyze porous material?

We can see the pore size and shape, but for the quantitative determination of degree of porosity, other tests are required.

### 8) Can we find the color images?

SEM initially gives black and white images. Nowadays, some feature extracting software is used to generate the color of the sample surface features.

**9) How to contact for SEM analysis?**

Kindly call our laboratory manager at the following ‘contact us for further details.

**Contact us**

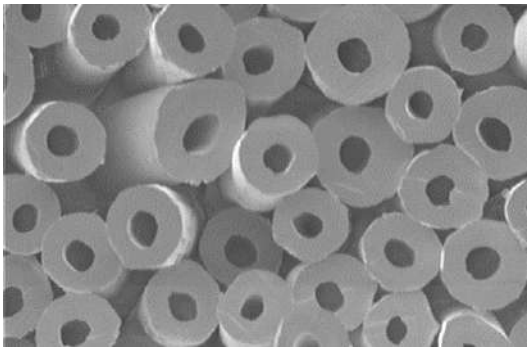
BTRA Test Laboratories: For testing related enquires such as test type, test charges, delivery time, etc.

- **E-mail: btloffice@btraindia.com; defectanalysis@btraindia.com**
- **Telephone: 022-62023636**

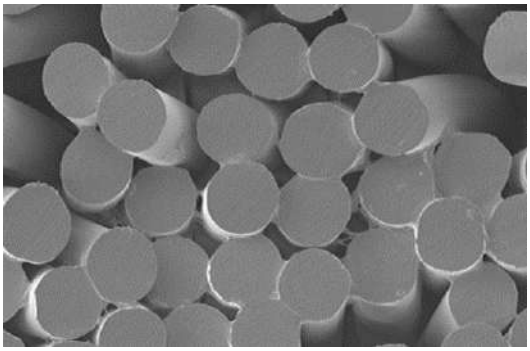
## A Gallery of SEM Lab Images

| | | | |
|---|---|---|---|
| **Cross-sectional Images** | **Longitudinal** | **Defects** | **Porous** |
| **Biological Samples** | **Pharmaceutical drugs** | **Spinneret** | **Cosmetics** |
| **Paints** | **Ceramics** | | |

### CROSS-SECTIONAL IMAGES OF FIBRES

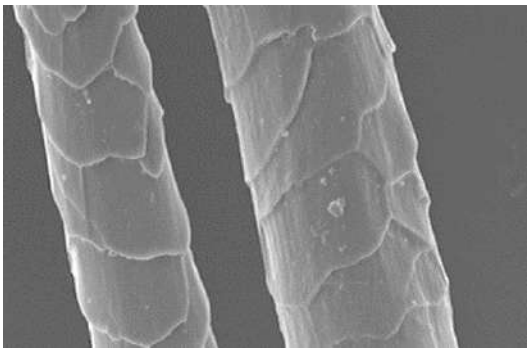


HOLLOW POLYESTER

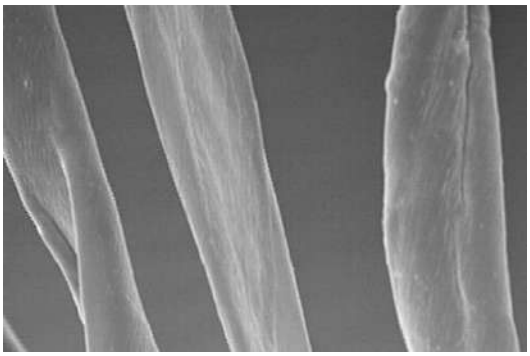


NYLON

### LONGITUDINAL IMAGES

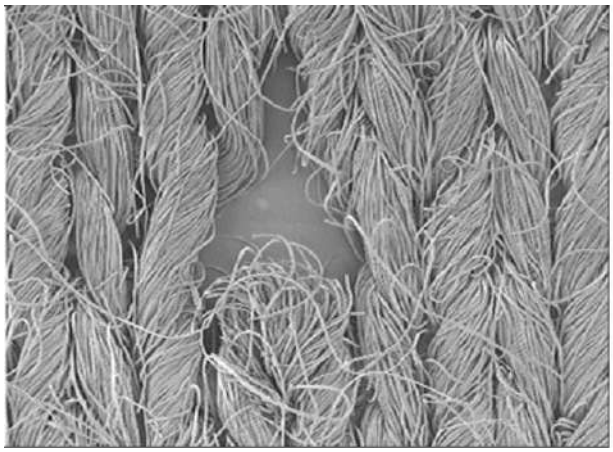


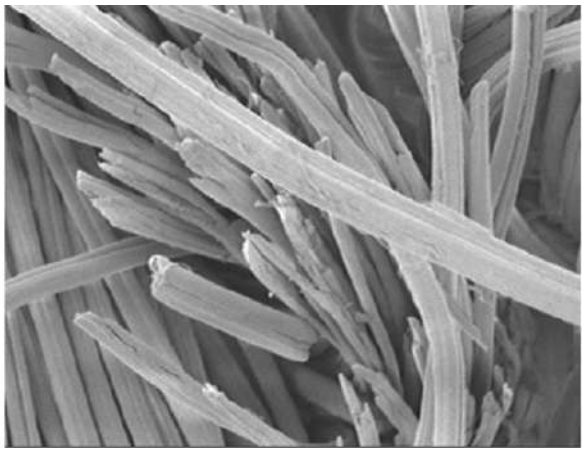
WOOL



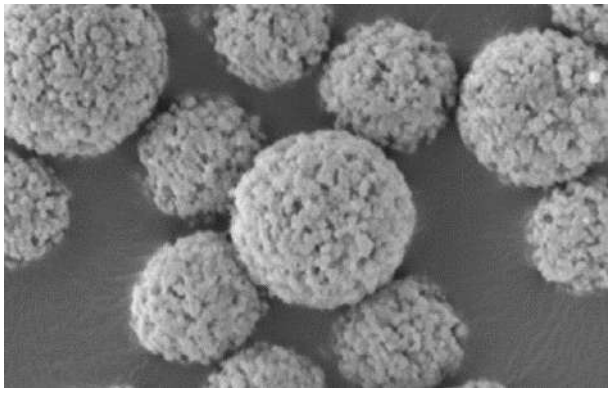
COTTON

## FABRIC DEFECT: HOLES IN THE FABRIC

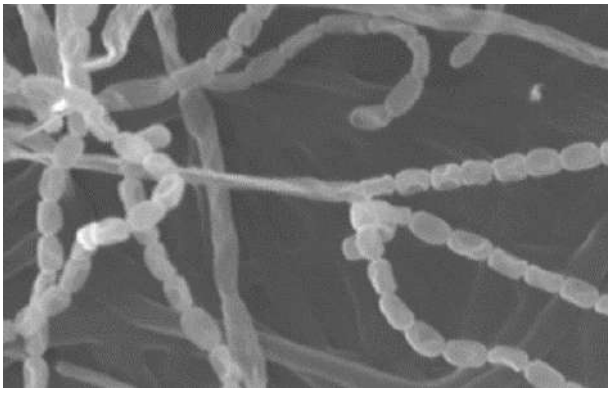




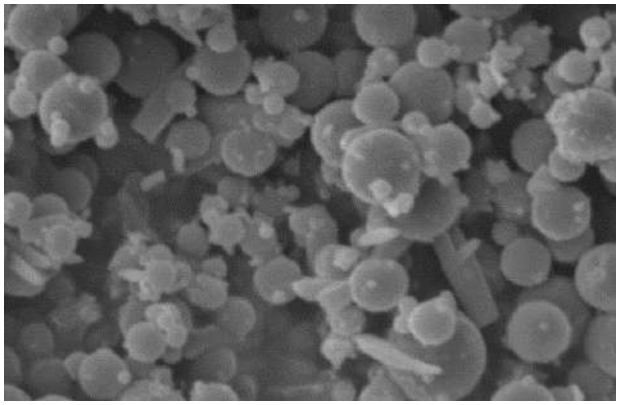
## PHARMACEUTICAL AND BIOLOGICAL SAMPLES



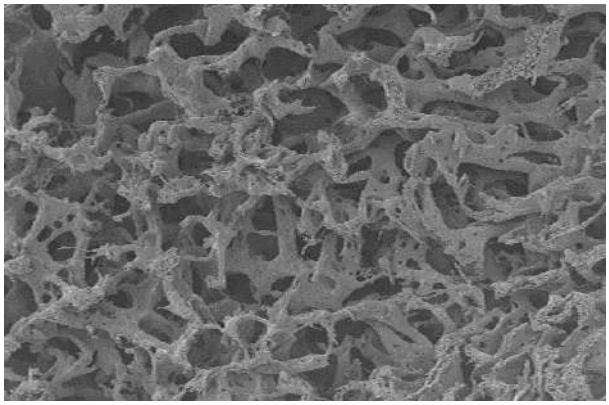
MACIM (DRUG)



ACTINOMYCETE CULTURE

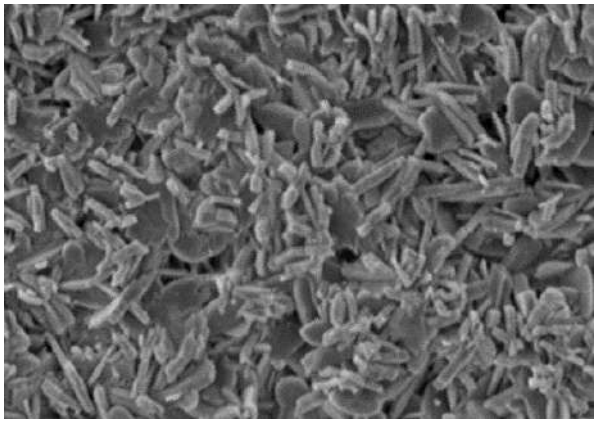


CURCUMIN DRUG

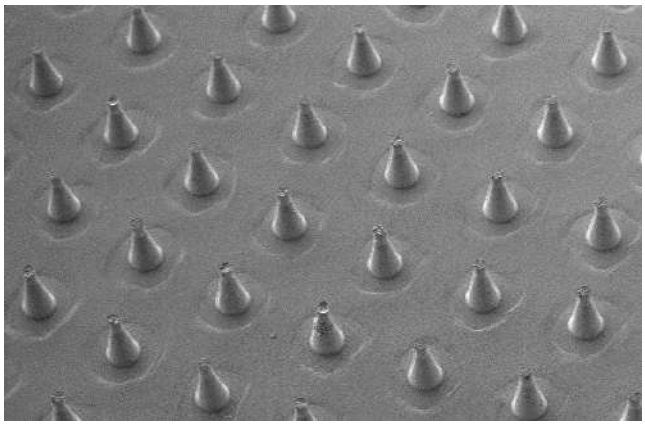


POLYMER SCAFFOLD

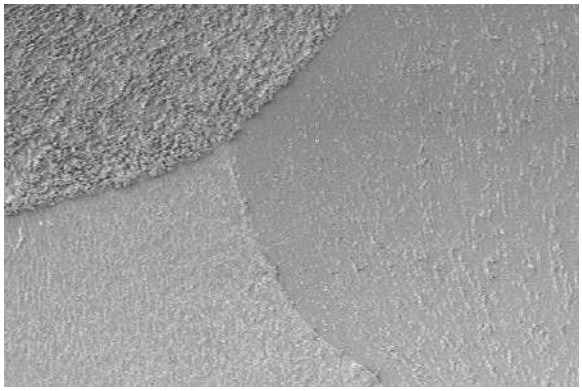
## OTHER SEM IMAGES



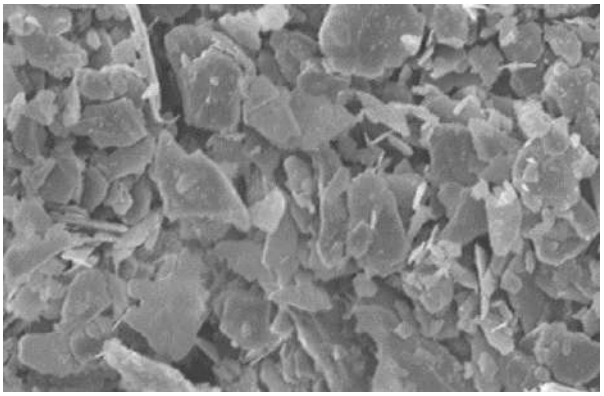
PHOSPHATED PAINT PANEL



REPLICA OF SPINNERETTE



WELD METAL



TALC POWDER