



# Study of Failure Analysis of Materials Using Scanning Electron Microscopy

## Failure Analysis

Scanning electron microscopes (SEMs) are a powerful tool in determining the causes of failure on the micro and nano scales on a wide range of materials.

The large depth of field characteristic of SEMs allows high spatial resolution imaging of sample surfaces at higher magnification than conventional light microscopes. Different modes of failure show different characteristic features on the surface of the sample, therefore looking at a SEM image of a fracture surface can help us identify the cause of failure in the material.

## Study of Fracture Surface with an SEM

Some of the fracture features that can be identified in an SEM image include microvoid coalescence, intergranular and transgranular fracture and fatigue striations.

Microvoid coalescence is characteristic of ductile fractures, where microvoids grow during plastic deformation of the material and eventually separate at the fracture surface showing their characteristic dimpled structure (see Figure 1).

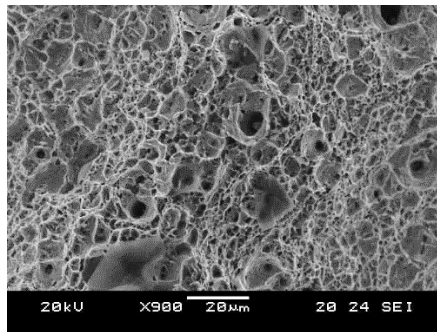


Figure 1: SEM image of Microvoid Coalescence

Intergranular and transgranular fracture are characteristic of brittle fractures where fracture occurs along the grain boundaries and across the material grains respectively (see Figure 2).

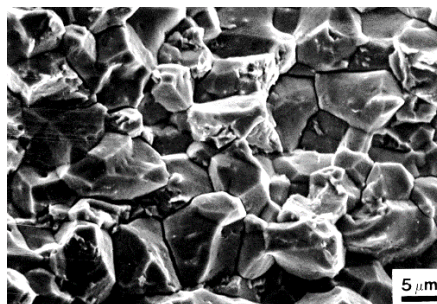
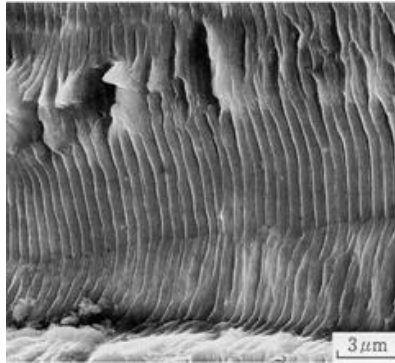


Figure 2: SEM image of Intergranular Fracture (Image from Vac Aero)

Fatigue striations are characteristic of slow, repetitive or cyclic load and occur at stress levels below the yield strength of the material.



*Figure 3: SEM image of fatigue striations (image from Wikipedia)*