



IIT ROORKEE



NPTEL ONLINE
CERTIFICATION COURSE

Failure Analysis & Prevention

Fundamental Sources of Failure: Improper manufacturing conditions

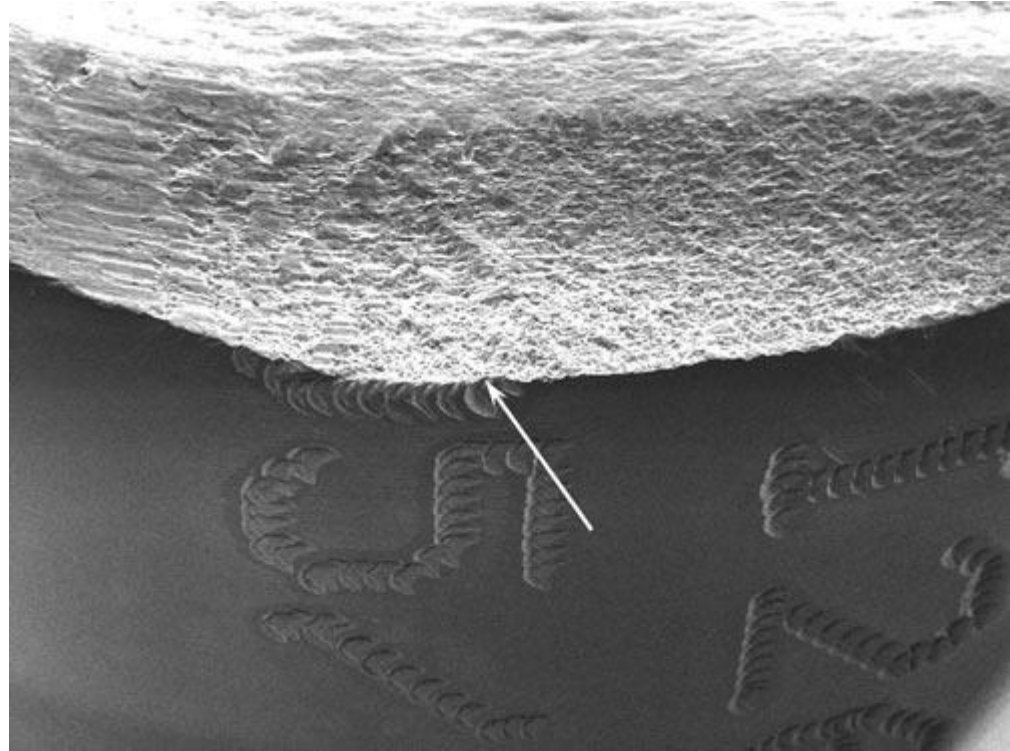
DHEERENDRA KUMAR DWIVEDI

MECHANICAL & INDUSTRIAL ENGINEERING DEPARTMENT



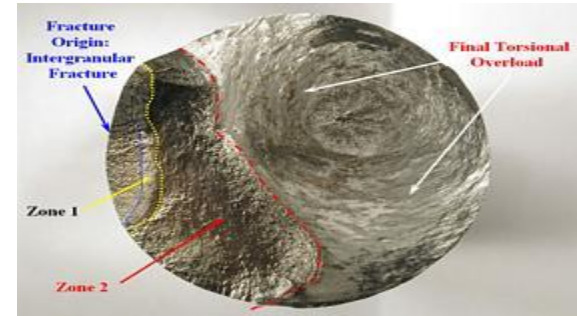
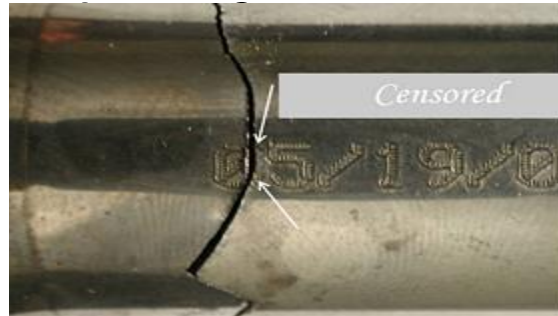
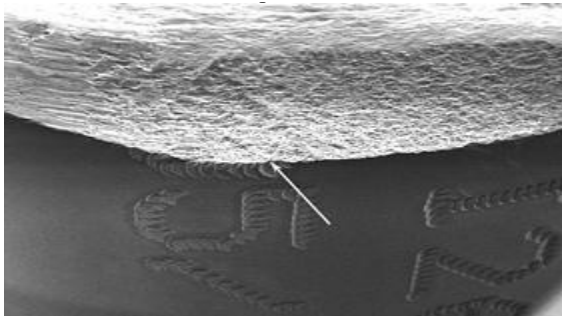
Identification marks

- Severe localized deformation
- Electro-chemical etching
- Increase cracking as these act as stress raiser especially in high stress areas



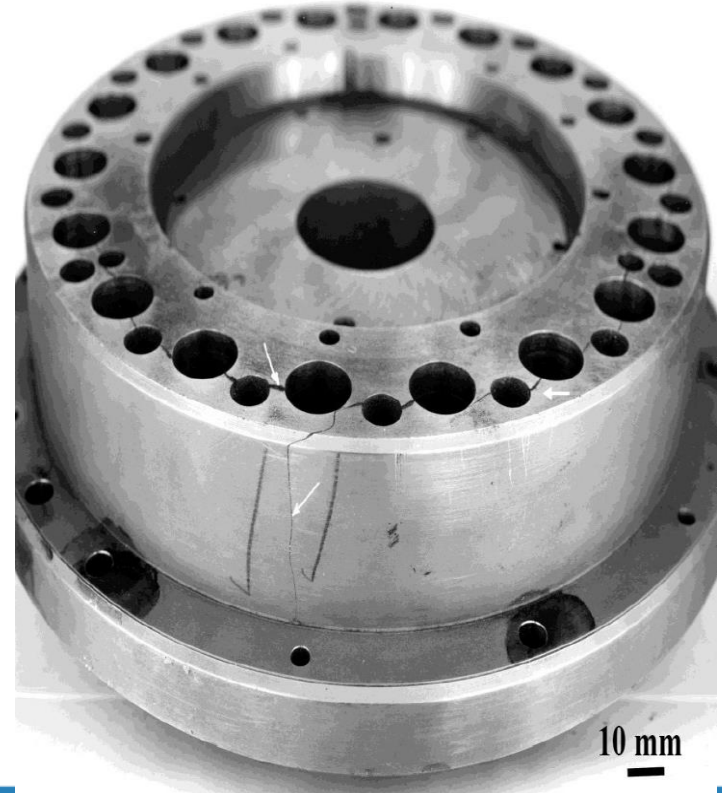
Identification marks

- Impact indentation/electro-etching in high stress areas acts as stress raiser
- HAZ and hardened steel ($>HRC\ 50$) develop

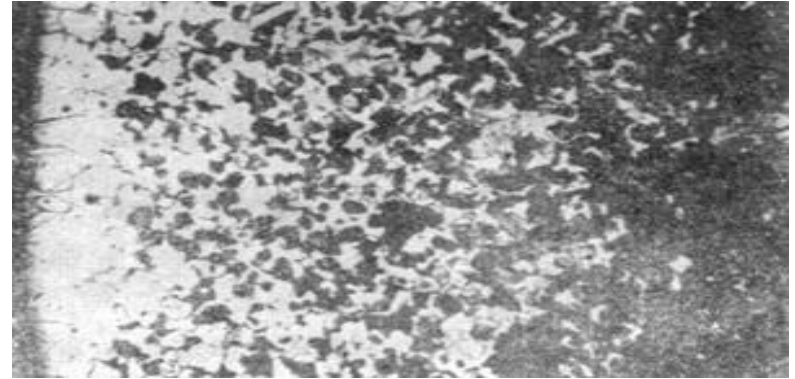


Improper heat treatment

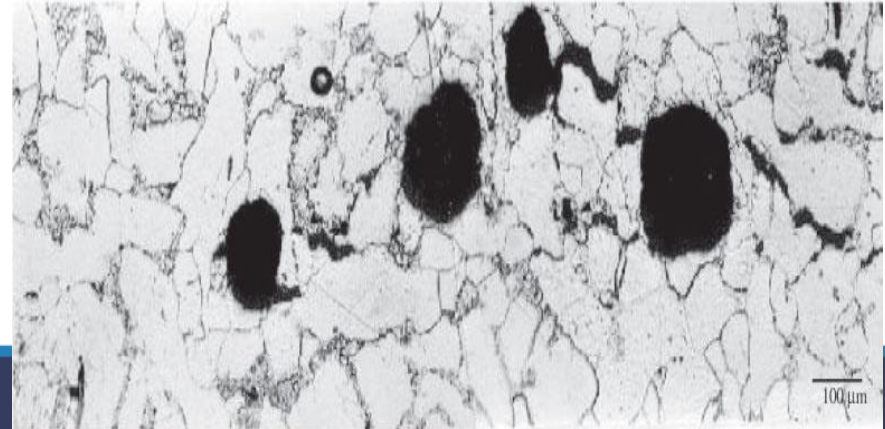
- Overheating : partial melting, coarsening, oxidation, decarburizing
- Under/over tempering (low strength)
- Thermal shock: high temperature gradient (quench cracks)
- Unsuitable heat treatment for specific alloy: Annealing, quenching, precipitation hardening
- Loss of alloying element (decarburizing) reducing tensile and fatigue strength
- More problematic of surface stress is high like springs and shafts
- Improper control over parameters of heat treatment



Decarburization



Overheating and carburization



Acid pickling / electroplating

- These introduce H_2 and can lead to HIC in high strength steels
- Chemical cleaning followed by coating development does not allow escaping of H_2



Reworking /repairing

- Involves partial processing of metals like welding, metal deposition
- Residual stress due to welding under restraint conditions
- These lower tensile, fatigue strength and increase cracking
- Hardening of previous HAZ

