

Stress Corrosion Cracking *(Introduction)*

LECTURE 01

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References:

- ▶ ***Stress-Corrosion Cracking: Materials Performance and Evaluation,***
Edited by R.H. Jones, 2017
- ▶ ***Stress Corrosion Cracking, Theory and Practice,***
Edited by V.S.Raja, T. Shoji, 2011
- ▶ ***Stress Corrosion Cracking of Pipelines,***
Edited by Y.F. Cheng, 2013

Evaluations:

- ▶ *Midterm Exam: 10 April 2018 (21 Farvardin 1397)* 5 pts.
- ▶ *Final Exam: 12 June 2018 (22 Khordad 1397)* 10 pts.
- ▶ *Presentations:* 3 pts.
- ▶ *Homeworks:* 2 pts.

Definition

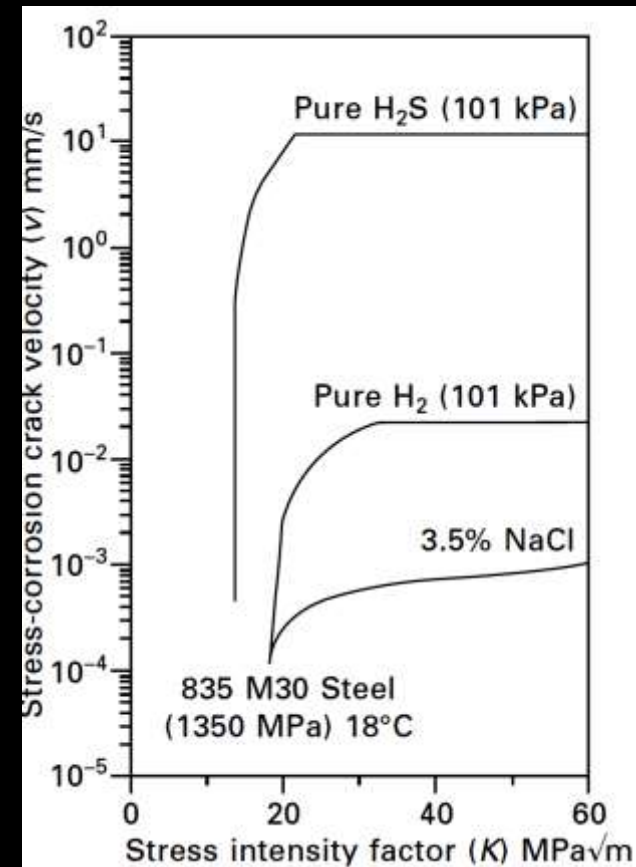
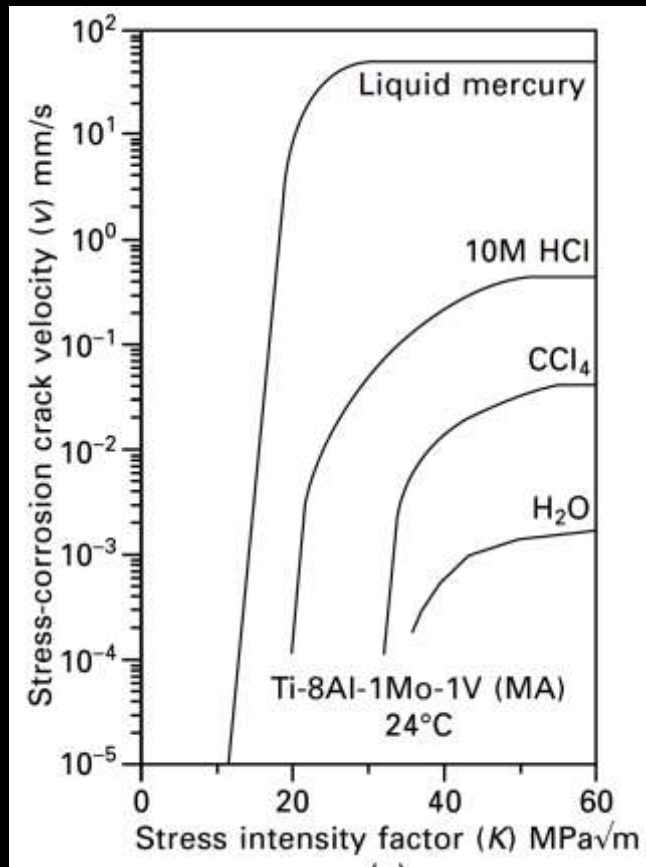
- ▶ *Sub-critical cracking of materials under sustained loads (residual or applied) in most liquid and some gaseous environments*
- ▶ *Sub-critical cracking of materials in gaseous hydrogen or hydrogen sulphide, and cracking due to internal hydrogen resulting from pre-exposure of materials to hydrogen-bearing environments, are considered to be forms of hydrogen embrittlement (HE).*
- ▶ *SCC in some materials can involve generation and ingress of hydrogen at crack tips.*
- ▶ *Sub-critical cracking in liquid-metal environments is also considered to be liquid-metal embrittlement (LME)*

Rate and expense of SCC

- ▶ SCC occurs in a wide range of materials/environments at rates varying from $\sim 10^{-2}$ m/s to $< 10^{-11}$ m/s (< 0.3 mm/yr)
- ▶ SCC of an austenitic steel lever-arm-pin (worth about \$10) in a military jet engine, leading to a series of events that caused the crash of the aircraft (worth about \$10 million)

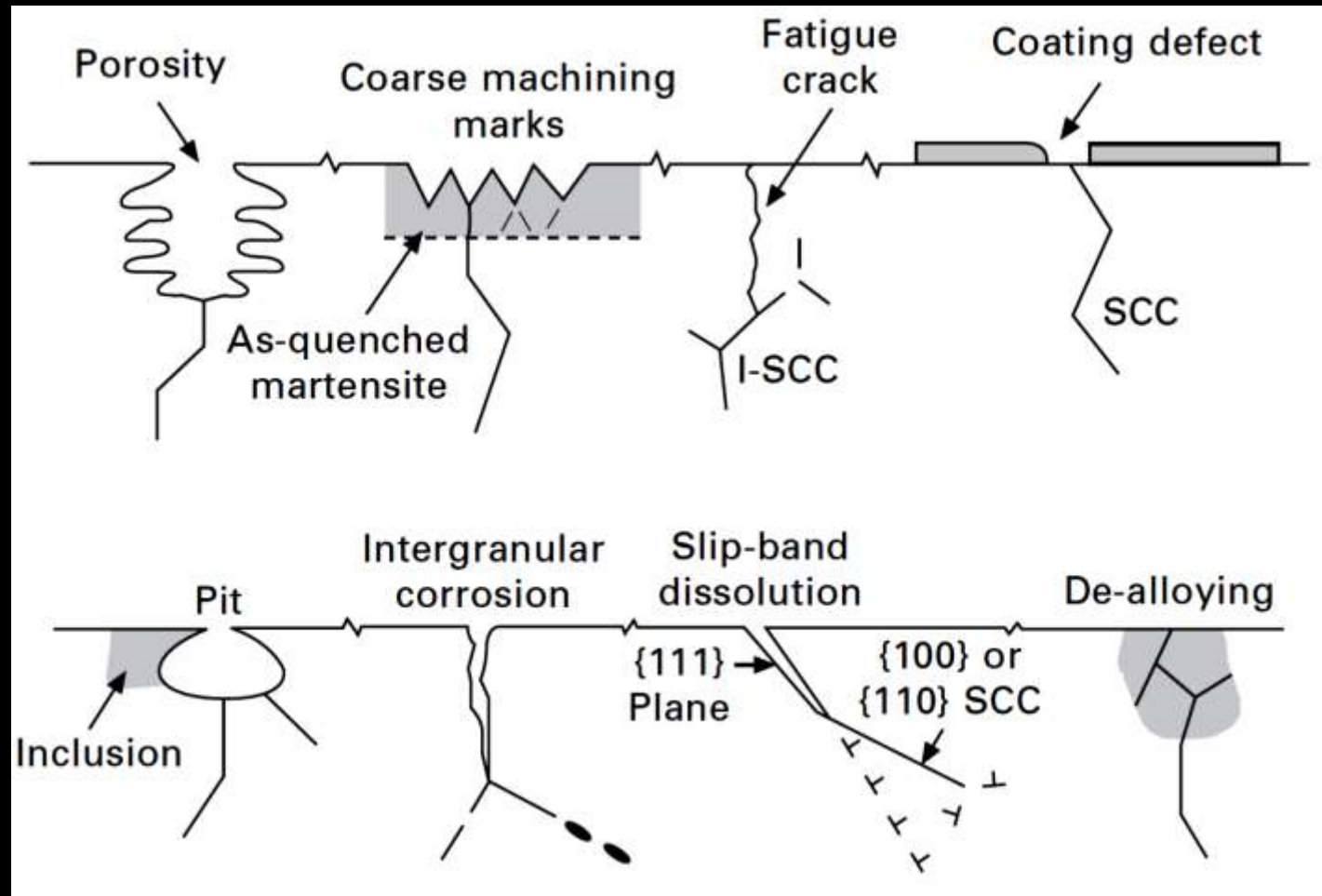
Quantitative measures of SCC

- ▶ *threshold stresses for SCC can be as low as 5% of the yield stress*

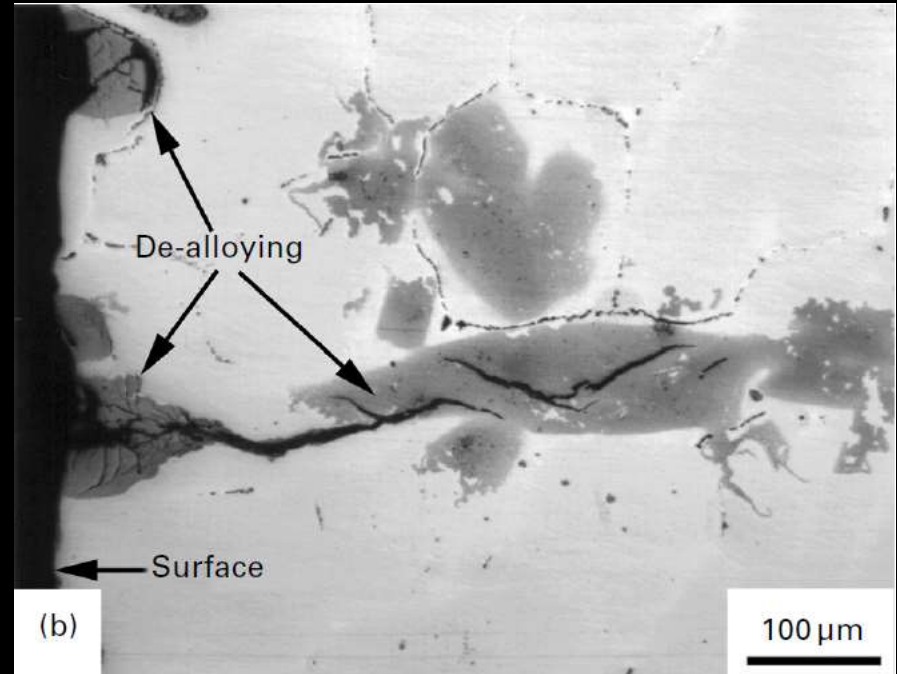
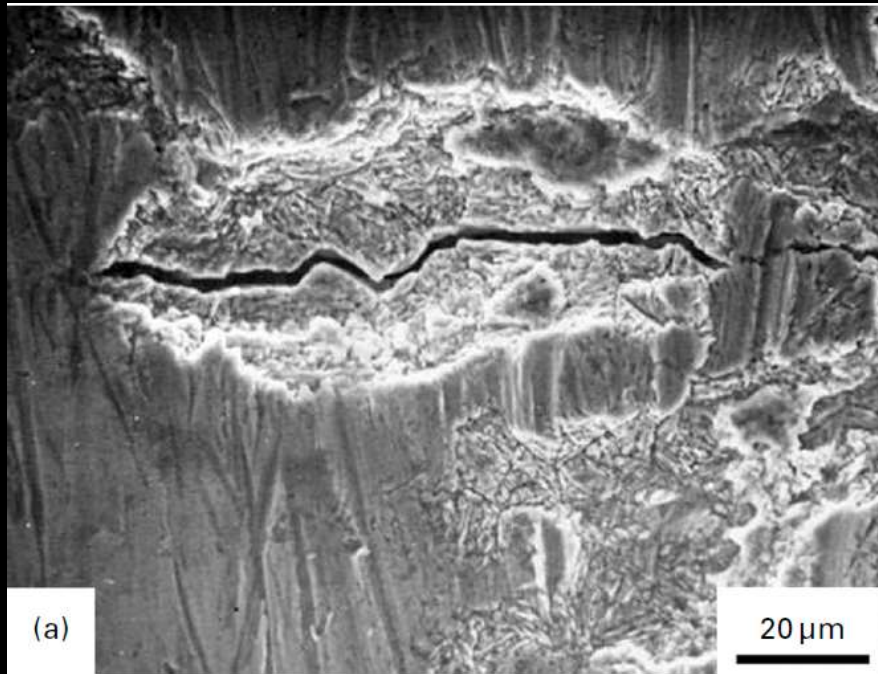


Phenomenology of stress-corrosion cracking (SCC)

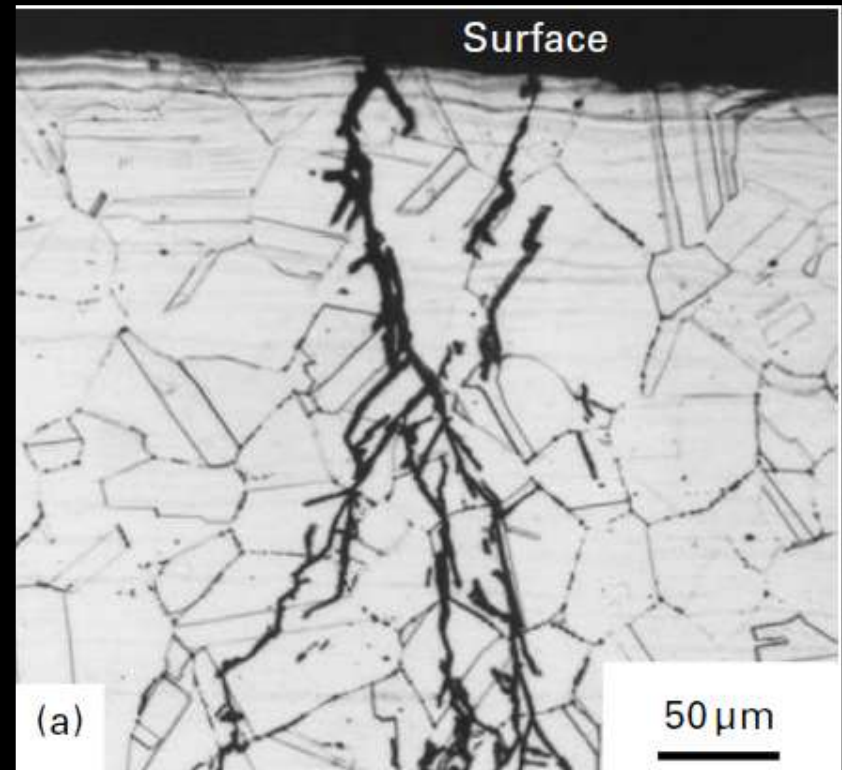
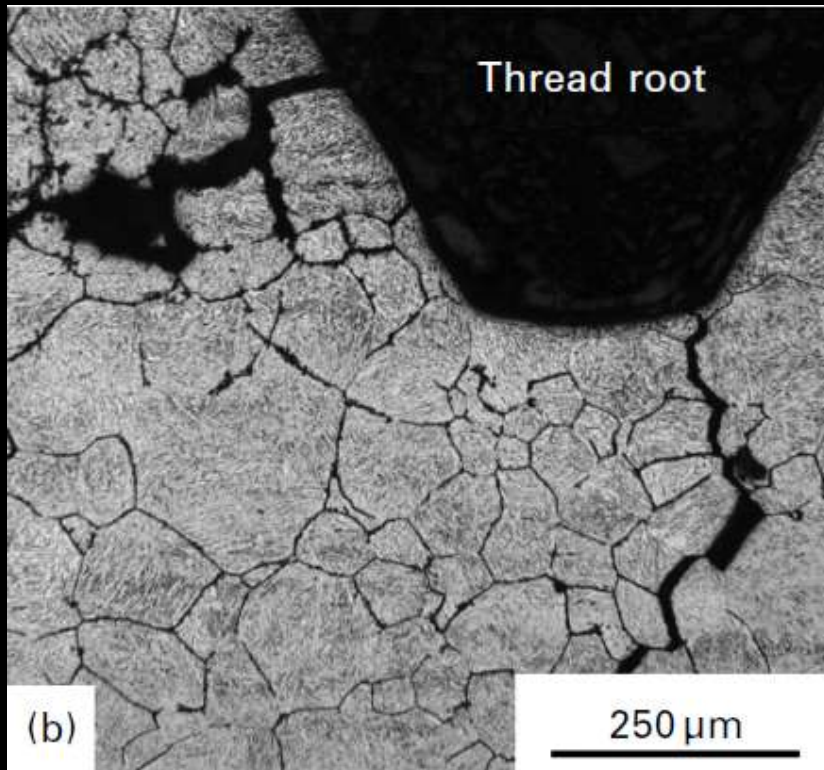
► 1- Crack Initiation



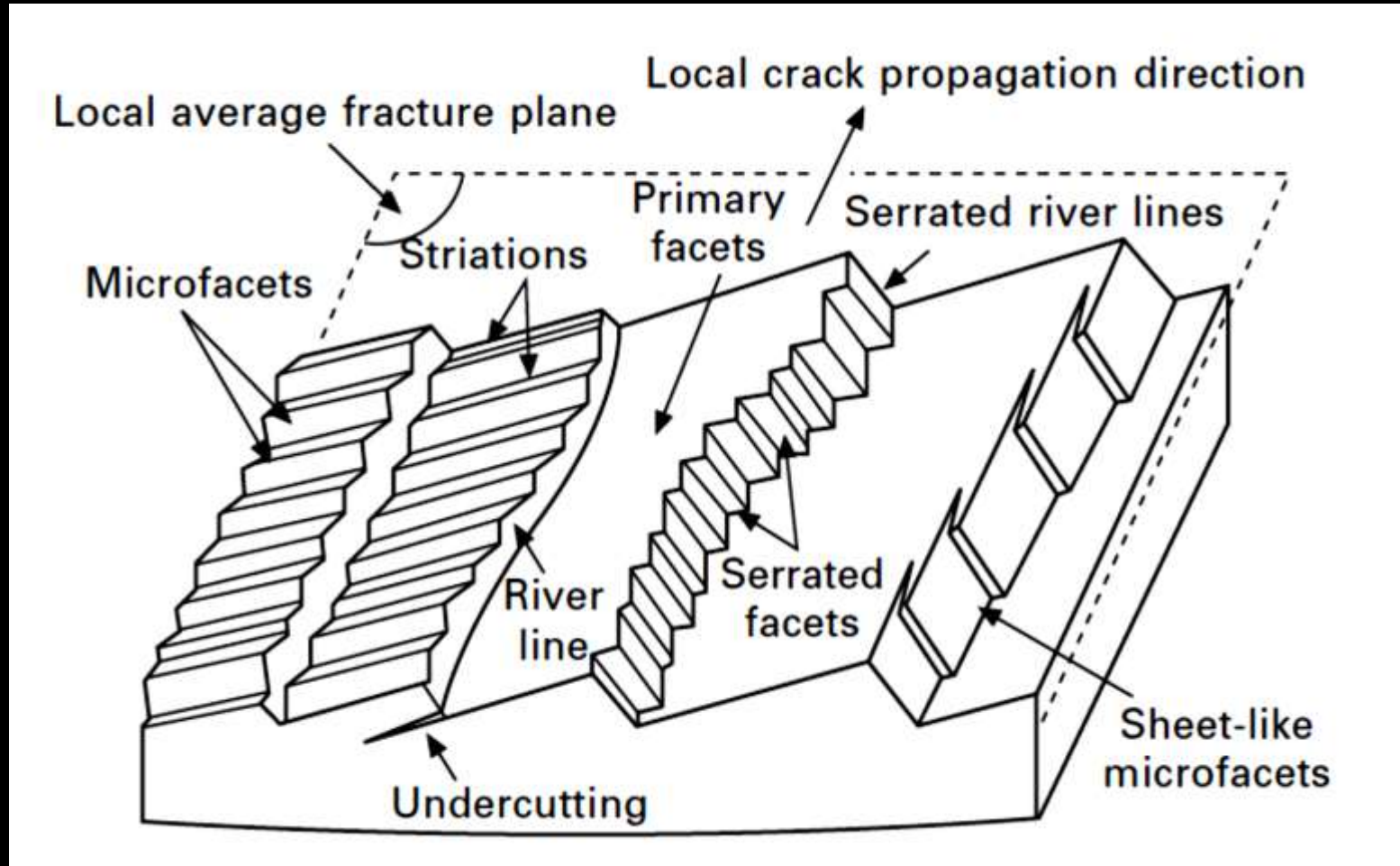
crack-initiation from a de-alloyed Mn-rich phase in a Mn-Cu alloy



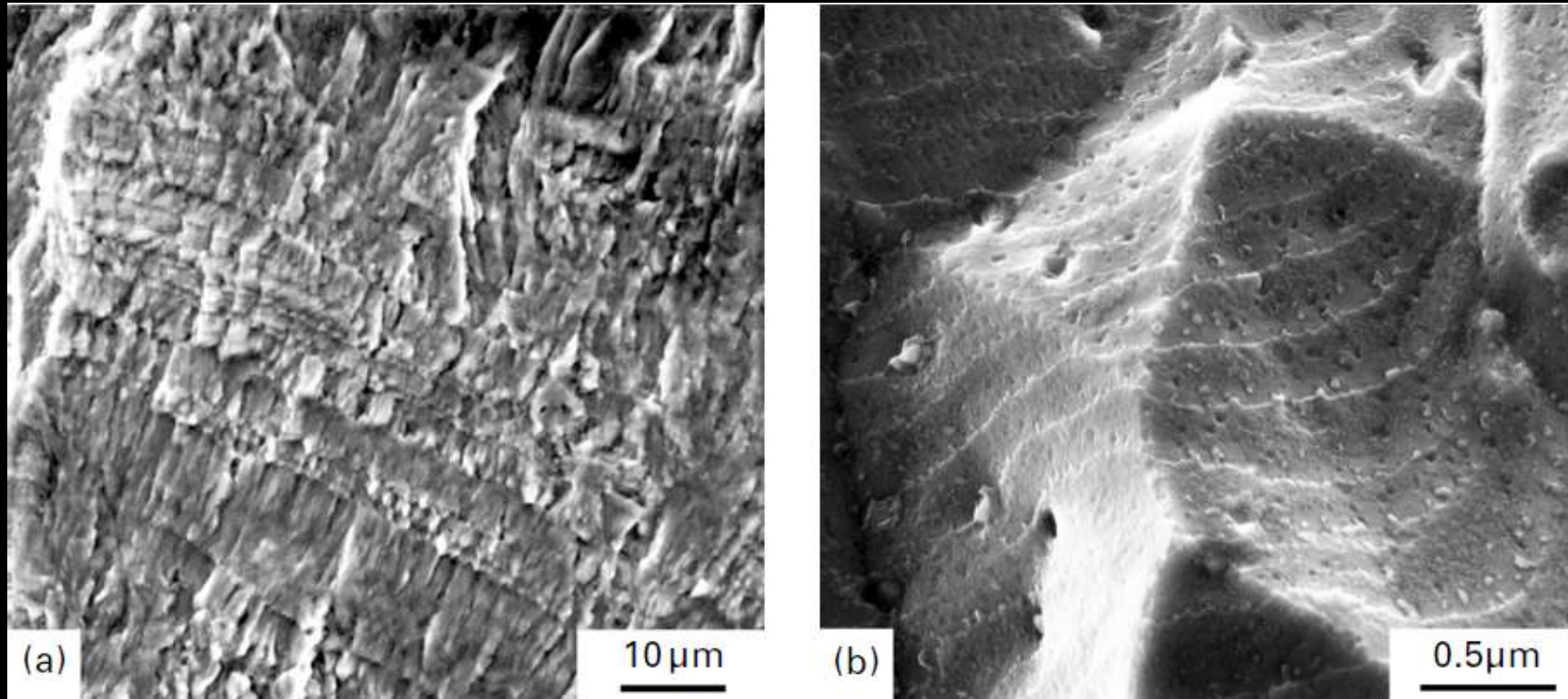
► 2- Crack Growth



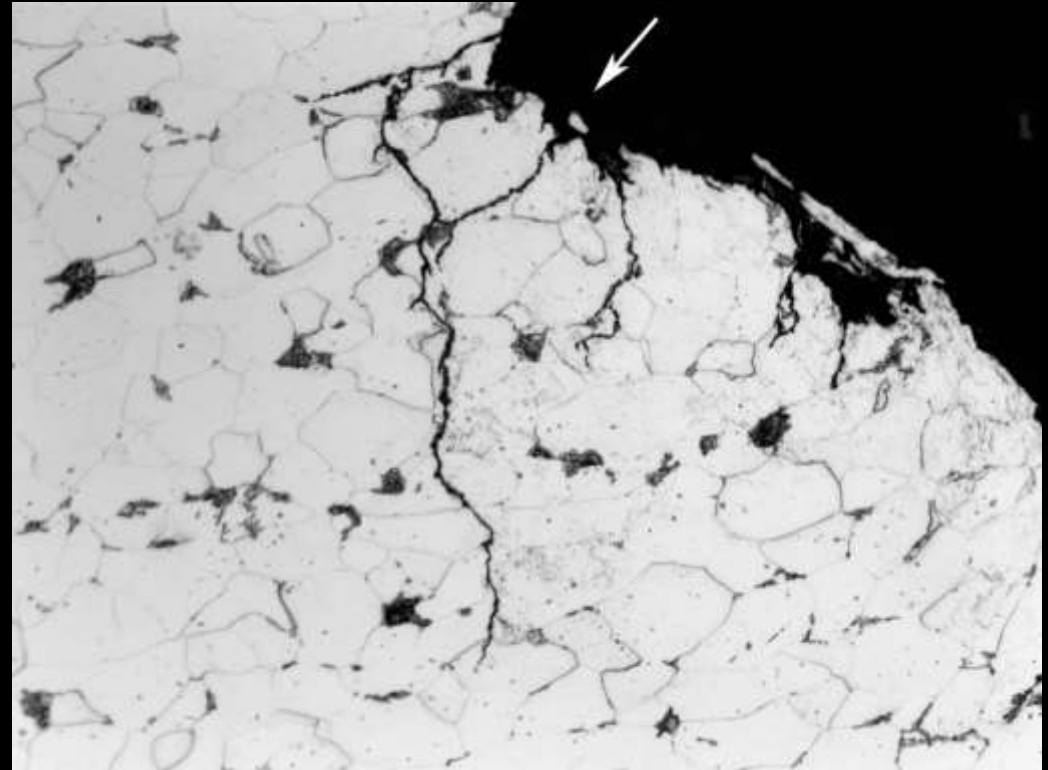
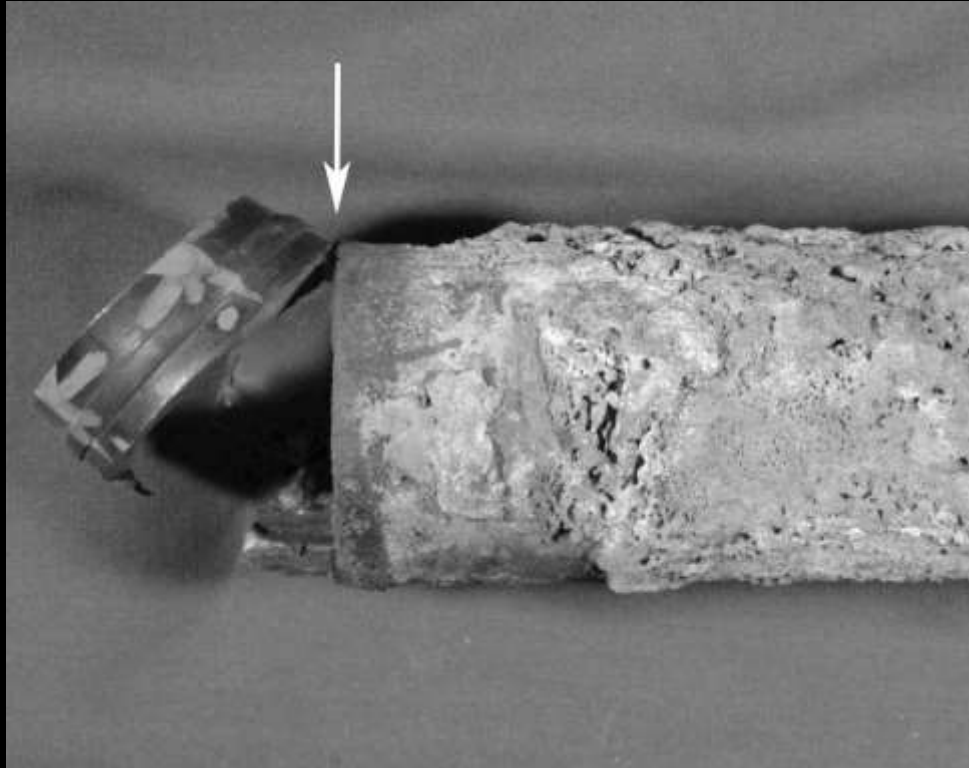
Cleavage-like SCC



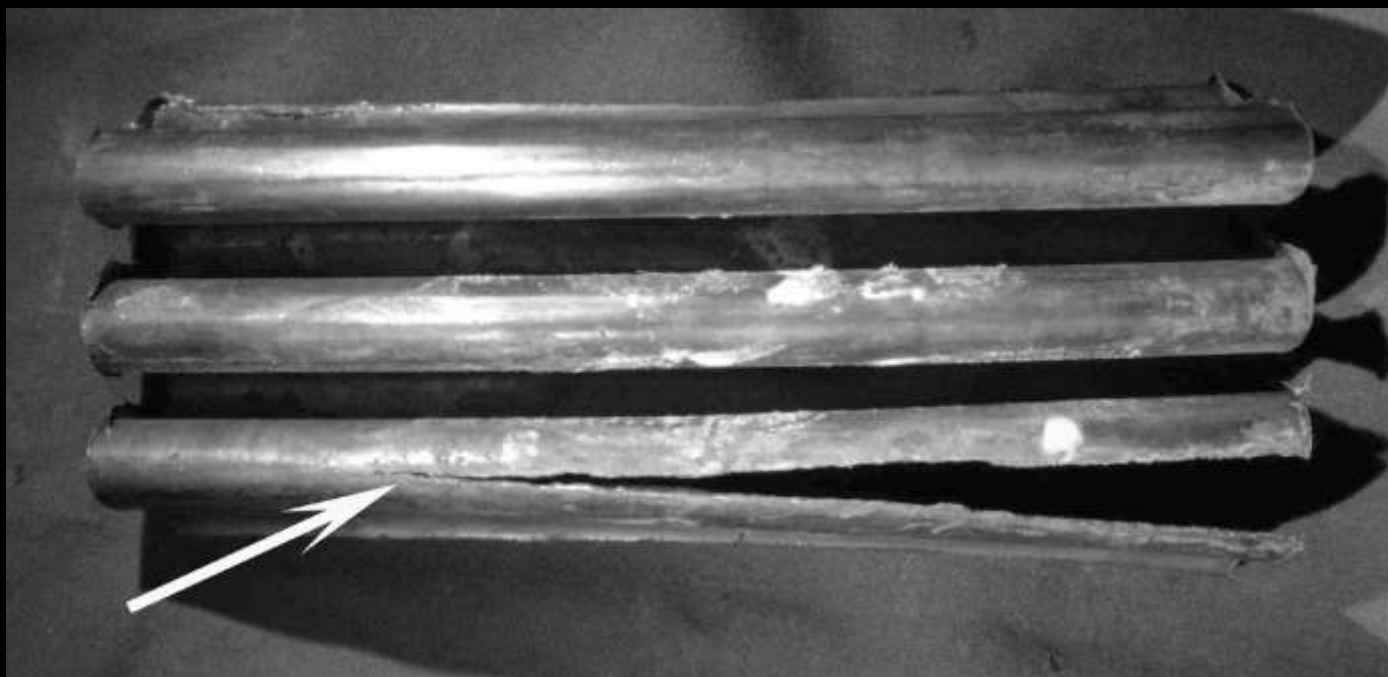
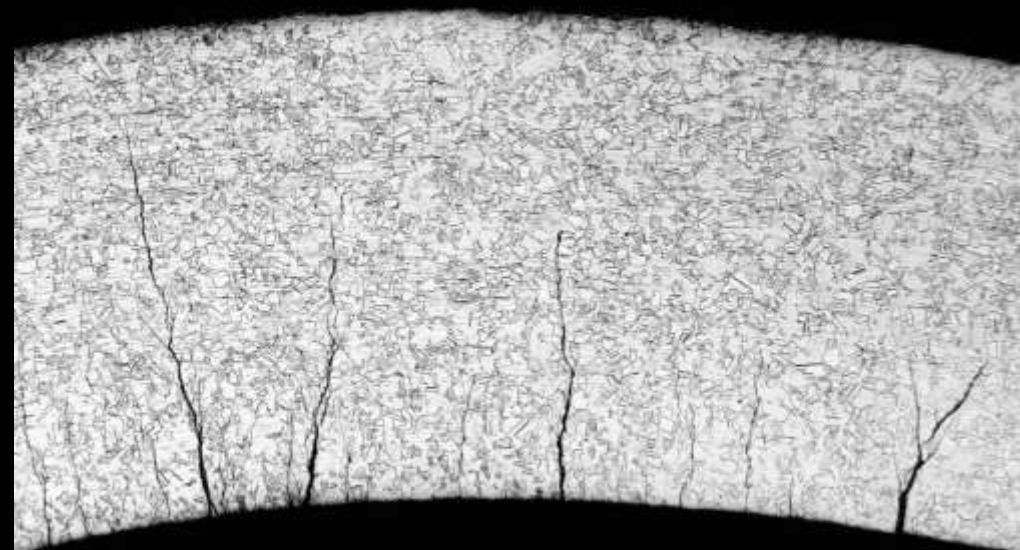
Crack-arrest markings (CAMs)



Boiler Tube



Expansion Joint



Main Landing Gear (MLG)

