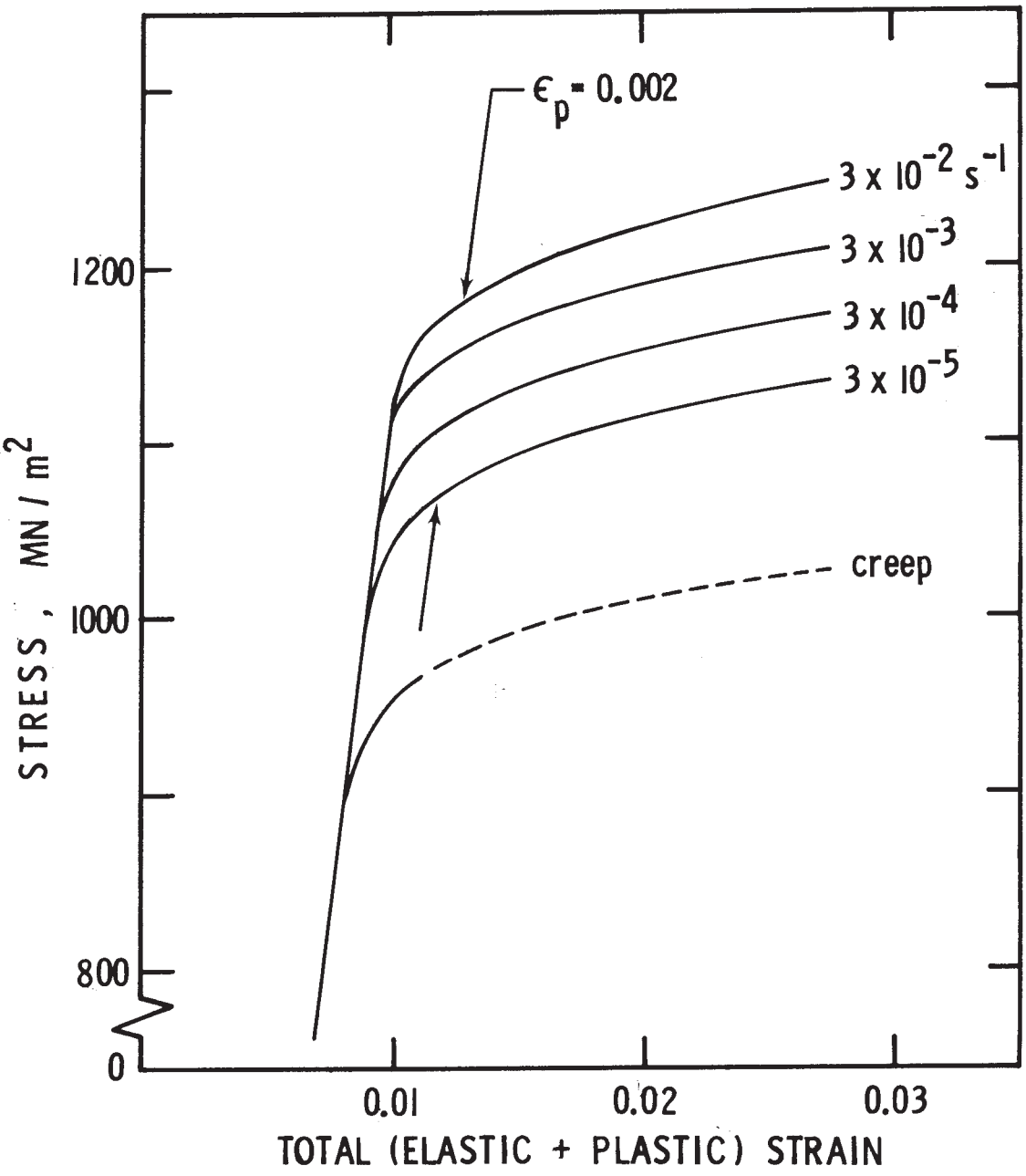
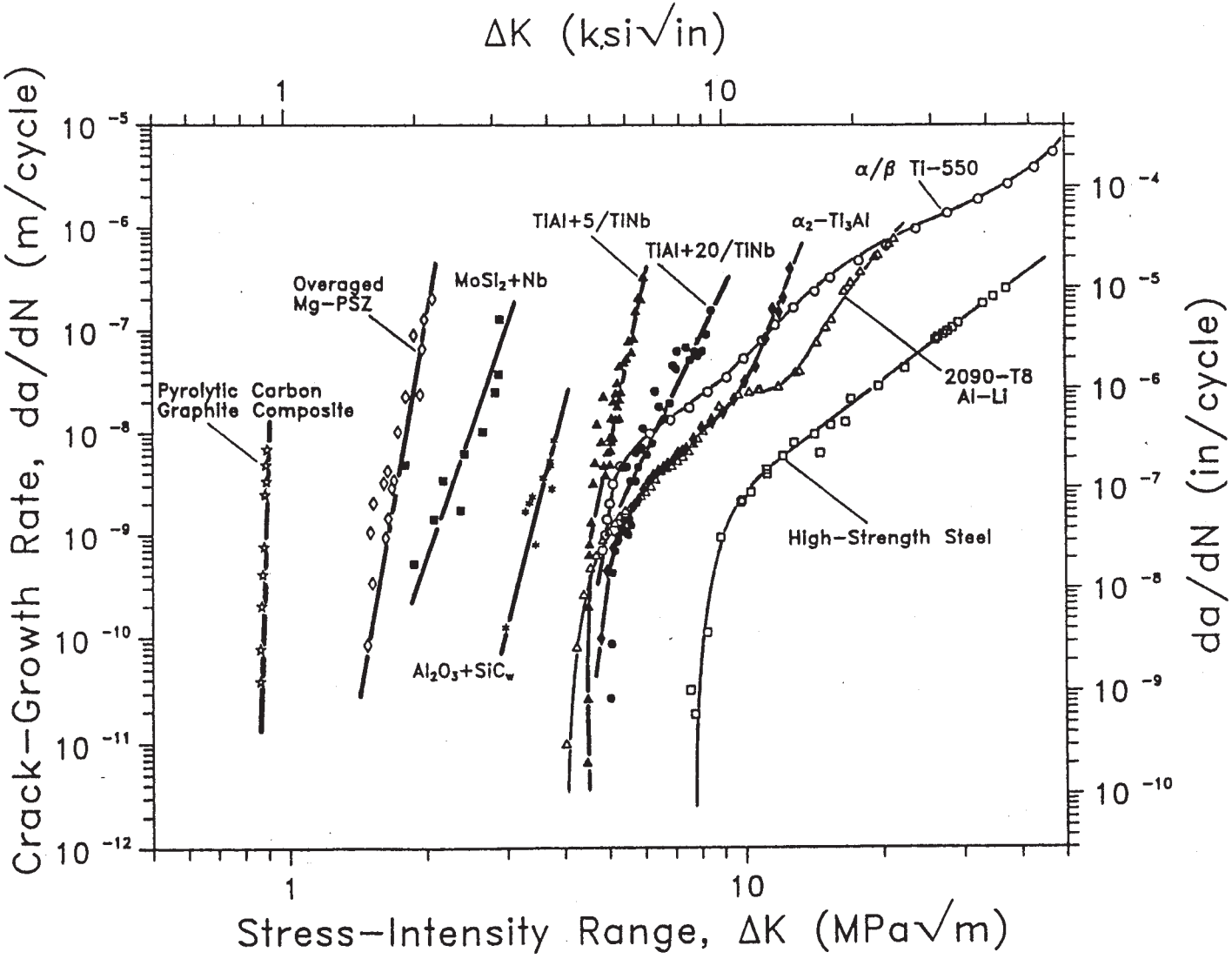


Effect of strain rate on flow curve at room temperature for a material susceptible to Stage I creep, Ti-6 Al-4 V. Note suppresssed zero on ordinate.

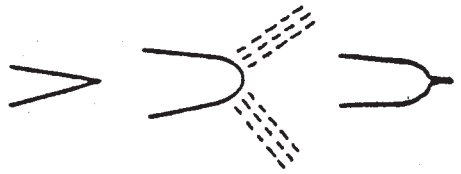
Metals, Intermetallics & Ceramics: Fatigue



Mechanisms of Fatigue in Ceramics

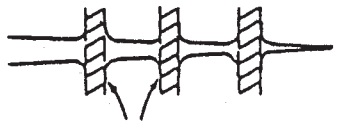
- Intrinsic Mechanisms (metals)
  - microstructural damage and crack advance mechanisms unique to cyclic fatigue loads
- Extrinsic Mechanisms (ceramics)
  - crack advance mechanism identical to that under monotonic loads
  - fatigue-crack growth promoted by suppression of shielding in crack wake

Crack Tip Blunting/Resharpening Continuum



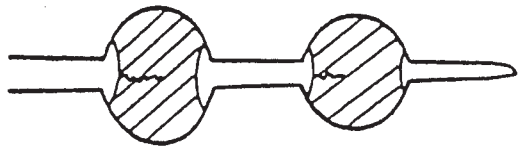
Damage to Bridging Zone
– friction and wear degradation of:

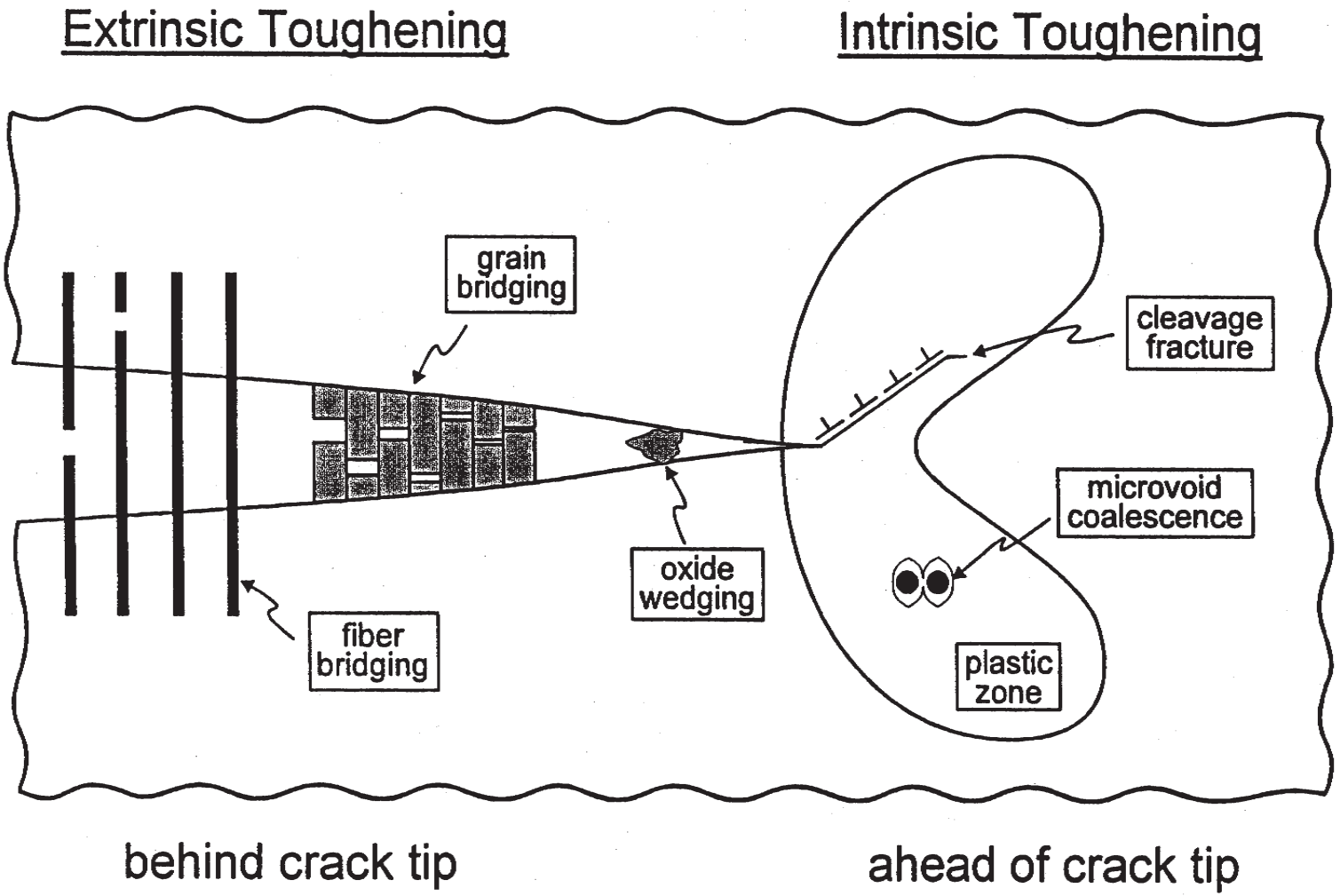
unbroken ligaments



whisker/fiber reinforcements

Fatigue of Ductile Reinforcing Phase




Extrinsic Toughening
Intrinsic Toughening
grain bridging
cleavage fracture
microvoid coalescence
oxide wedging
fiber bridging
plastic zone
behind crack tip
ahead of crack tip

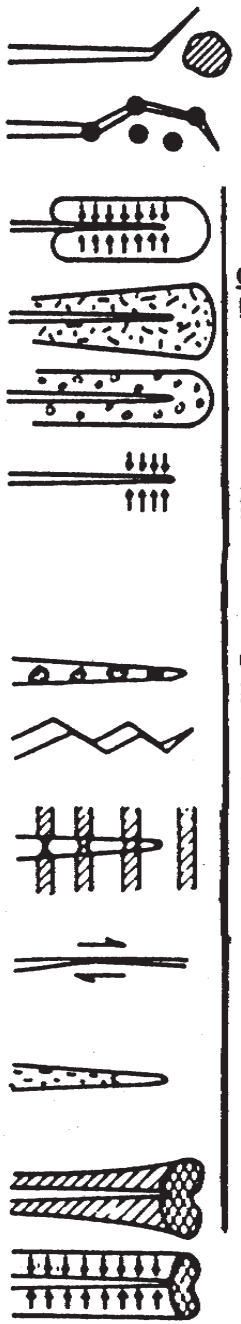
EXTRINSIC TOUGHENING MECHANISMS

1. CRACK DEFLECTION AND MEANDERING

2. ZONE SHIELDING
   - — transformation toughening
   - — microcrack toughening
   - — crack wake plasticity
   - — crack field void formation
   - — residual stress fields
   - — crack tip dislocation shielding

3. CONTACT SHIELDING
   - — wedging:
     - corrosion debris-induced crack closure
     - crack surface roughness-induced closure
   - — bridging:
     - ligament or fiber toughening
   - — sliding:
     - sliding crack surface interference
   - — wedging + bridging:
     - fluid pressure-induced crack closure

4. COMBINED ZONE AND CONTACT SHIELDING
   - — plasticity-induced crack closure
   - — phase transformation-induced closure



	MONOTONIC LOADING	CYCLIC LOADING
CRACK DEFLECTION	K^{∞} ↓ K_{tip}; K_I reduced	ΔK reduced, R constant
ZONE SHIELDING	↓; K_I reduced	ΔK constant, R reduced
CONTACT SHIELDING — Wedging:	↑; K_I increased	ΔK reduced, R increased
Bridging and Sliding:	↓; K_I reduced	ΔK reduced, R increased
Wedging and Bridging:	↑; K_I increased	ΔK reduced, R increased