Growth

1.) First instability to be recognized

- **1955 - 1st UN Conf. on Peaceful Uses of Atomic Energy**

- **US, USSR, and UK found tremendous variations in the behavior of polycrystalline rods**

- **Found: (figure)**

[010] Elongation
[100] Contraction
[001] No Change

2.) Growth rate at any time depends on the length at that time rather than the initial length.

$$L = L_o e^{Gf}$$

Where

G = growth const.
f = frac. of atoms that have fissioned

$$G = \frac{\ln\left(\frac{L}{L_o}\right)}{f}$$

normally report

$$\frac{\%\ \text{Growth}}{\%\text{Burnup}}$$

G is very temperature dependent (figure)

at 0.2% BU, (1850 MWd/tonne U)

$$\frac{L}{L_o} \approx 2\text{-}3 \quad @\ 100^\circ C$$

Texture Effects

(figure)

Elongated Rod (figure)

Explanation

- **Fission fragments cause local heating**
  - **expansion-100, 001 (attracts vacancies)**
  - **contraction-010 (attracts interstitials)**

- **Defect migration produces**
  - **Vacancy loops on {100} planes (actually on {110})**
  - **Interstitial loops on {010} planes**

Temperature Effects

- **Low temperatures---> Random Loops (interstitials)**
- **Moderate Temp.---> Vacancy Loops Aligned (80-350 °C)**
- **Above 500°C -----> Loops anneal out**