# Graphite progress update

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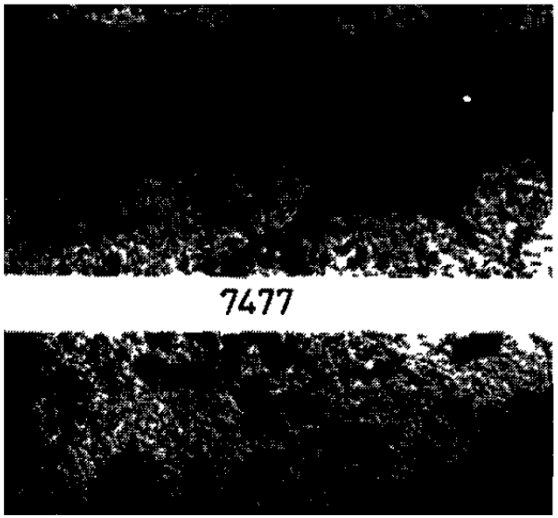
# Thermal shock

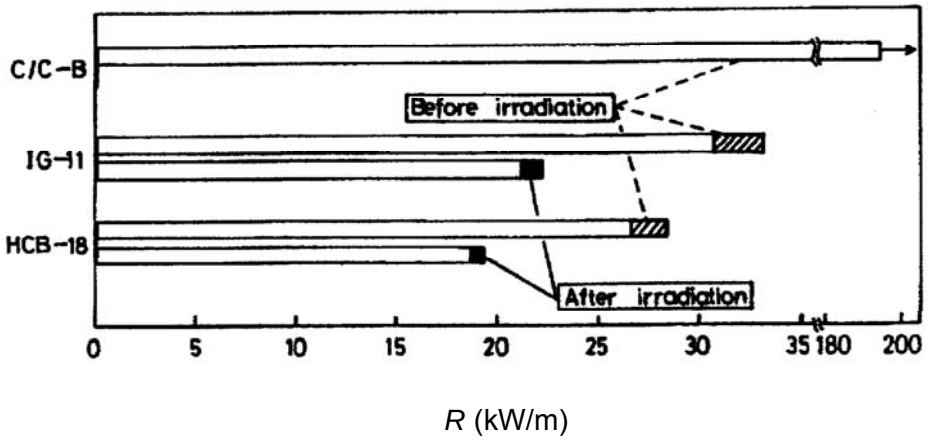
- Graphite has good thermal shock resistance (*R*)
  - use as crucibles, moulds, dies, and electrodes
- Unirradiated (calculated)
  - POCO ZXF-5Q ≈ 47 kW/m
  - Toyo Tanso IG-430 ≈ 112 kW/m
- Reduces with irradiation
- Reduces with oxidation

$$R = \frac{k\sigma_T}{\alpha E}$$

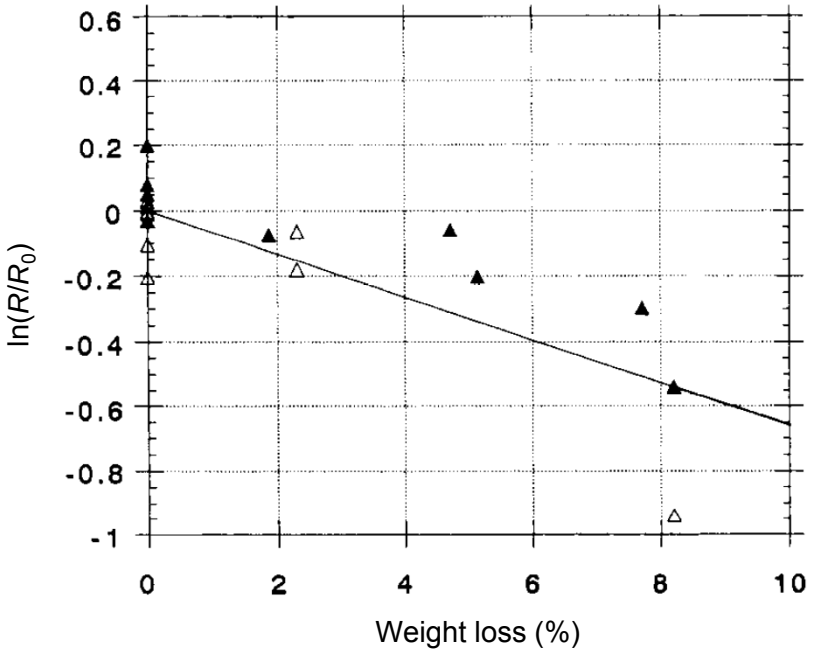
# Thermal shock




**Thermal shock resistance of graphites before and after irradiation to 16-17 × $10^{20}$ n/cm$^2$ (>0.18 MeV) at 600-850ºC (Sato *et al.*, 1980)**




**Thermal shock resistance of graphites before and after irradiation to 11-15 × $10^{20}$ n/cm$^2$ (>0.18 MeV) at 750-1000ºC (Sato *et al.*, 1989)**




**Thermal shock resistance of oxidised IG-430 graphite (Kurumada *et al.*, 1997)**

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# Summary

- LBNE
  - POCO ZXF-5Q, 1 dpa, ≤300ºC, no oxidation
- T2K
  - Toyo Tanso IG-430, 1 dpa, 700 to 800ºC, ~8% oxidation
- No ‘show stoppers’ found
  - no obvious better choice of grade
  - recommend (scoping) thermo-mechanical analyses
    - irradiation-induced dimensional and materials properties changes
    - oxidation
  - recommend further calculations (or experiments) on thermal shock resistance