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Understanding and Improving Graphite for Nuclear Fission

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SINOSTEEL

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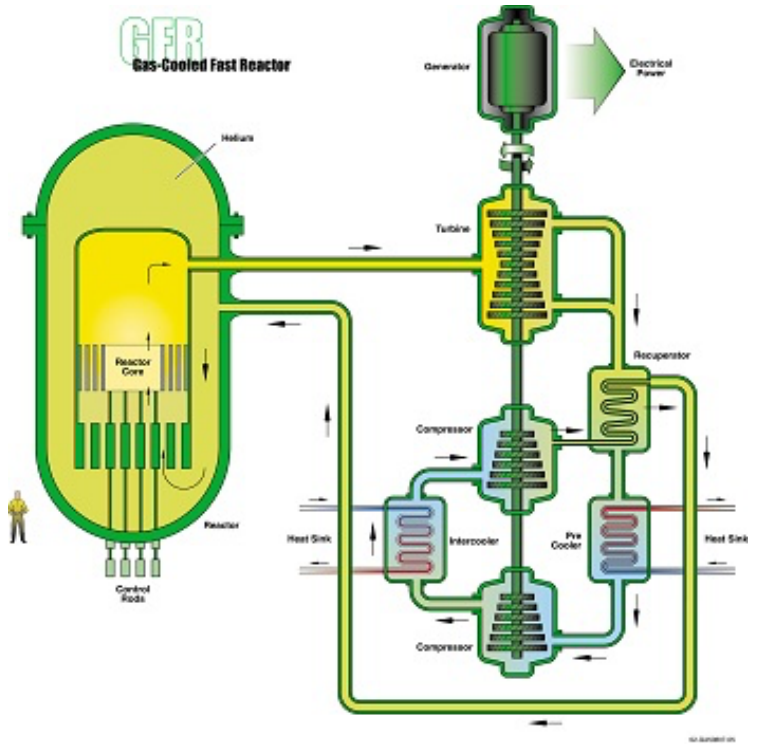
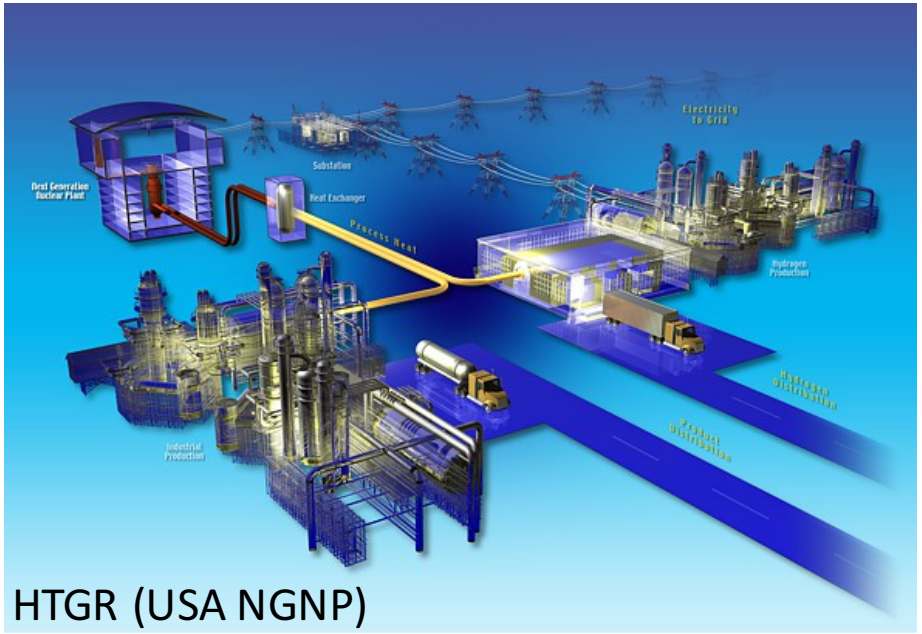
Next Generation Graphites for Gen IV

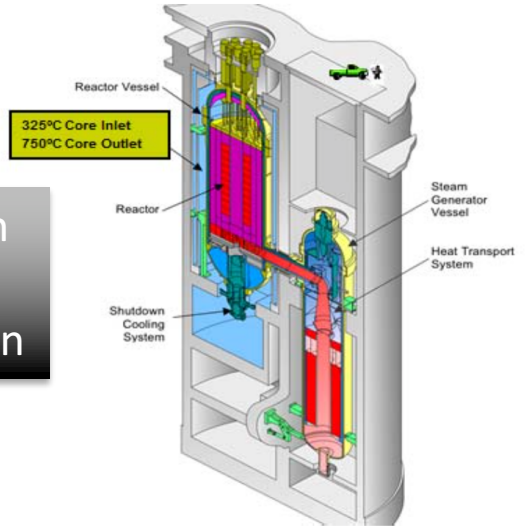




HTGR (USA NGNP)

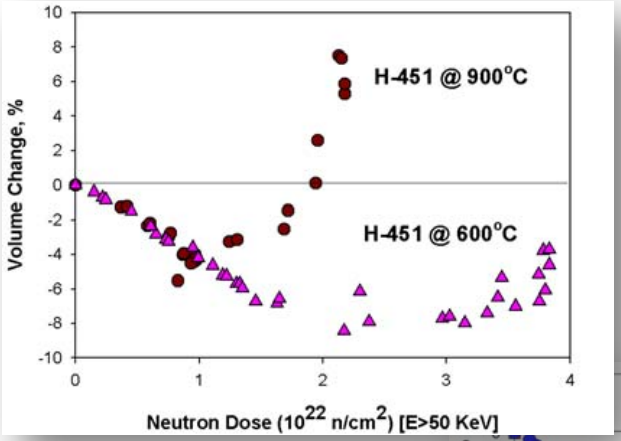
HTR-PM (China) (2014-)
(250 MWt, 750°C, Helium Cooled)

Graphite is a key structural material in advanced nuclear reactors for electricity and process heat generation

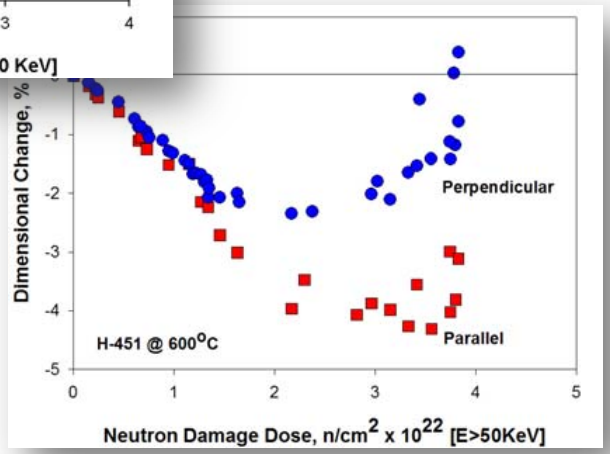


Why is Graphite Interesting?

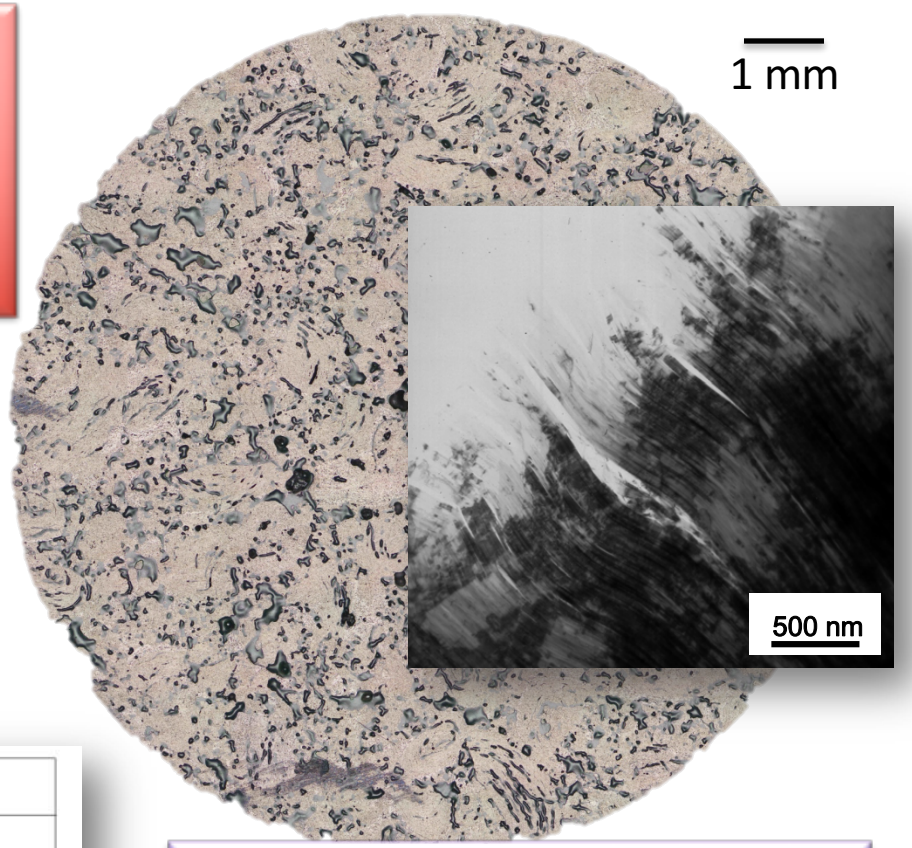
Need to improve knowledge on the correlations between nano- to mseo-scale microstructure and irradiation damage resistance in order to design and select graphite material with improved resistance to irradiation damage



Burchell et al

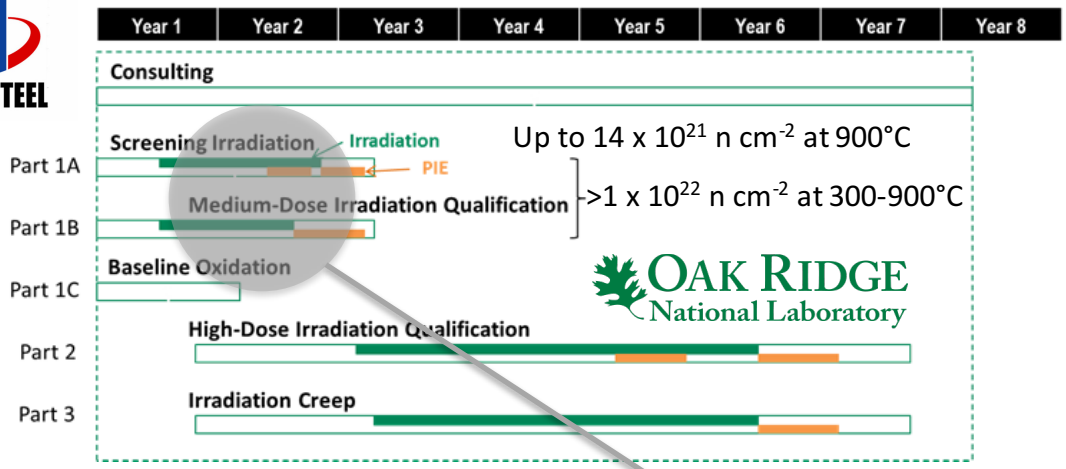


H451: extruded near-isotropic medium-grained nuclear grade graphite



Graphite has a structure at many length scales and is a network of connected crystals. This structure ***and*** its properties change with irradiation during reactor life

Opportunity and Methodology



Sinosteel/ORNL Irradiation Programme (Year 1 = 2015)

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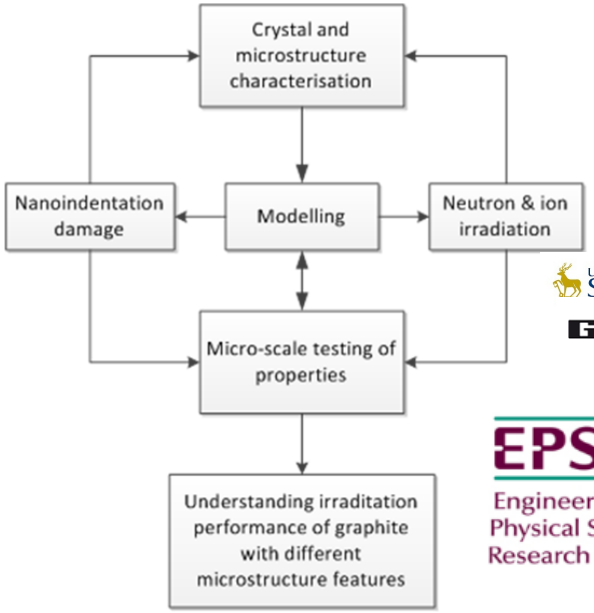
SINOSTEEL
- Producer of graphite for the Chinese HTR-PM programme,
- Funding the irradiations at ORNL to select graphites

Eight Graphites (2 x Filler @ 2 sizes, 2 x Binder)

- Characterisation over length scales:
  - Dimensional change, Young's modulus, thermal expansion, tensile strength, toughness
  - HR-TEM, nano-indentation, Raman, EELS
- Modelling at the meso-scale
  - MD atomistic simulations (up to ~50 nm^3) to predict physical and mechanical properties
- Testing at the meso-scale
  - In situ nano-indentation, pillar compression and Nano-XCT
  - In situ TEM testing with DIC and diffraction strain measurement



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