SiC/SiC: Chemical Compatibility

- **Pb-17Li coolant**
  - **Reaction: $2\ SiC + 2\ Li = Li_2C_2 + 2\ Si$**
  - **Fenici: 800 C/1500 h: CVI SiC/SiC stable**
  - **Terai: 300-500 C/ 666 h: SiC stable**
- **Li: SiC very unstable**
- **Helium + impurity O_2**
  - **SiC forms a protective SiO_2 layer.**
  - **Carbon interface reacts with O_2 to reduce strength, increase da/dt, creep**
  - **0.1 ppm O_2 should lead to 30 yr life, model calculations.**
  - **Transmutation of Li ceramic breeding material will release O_2 that will react with T to form T_2O: H_2O reacts with SiC to form SiOH (g), significant issue for turbine applications but no information on lower concentrations of H_2O.**
- **On-going work: da/dt in Ar+H_2O at 800 to 1100 C, Type S SiC/SiC composite**

SiC/SiC: Coatings

- **Candidate materials**
  - **Ductile metals such as V**
  - **Glasses that can flow to relax stresses**
  - **SiC seal coat**
  - **Advanced composite coatings: Ti_3SiC_2 + SiC, thermal fatigue**
- **Status**
  - **European work with glass coatings**
  - **SiC: not likely to work because it will microcrack**
- **On-going work:**
  - **Proposal to evaluate ductile metal coatings: in situ creep tube will provide coating, irradiation creep and burst strength data.**

SiC/SiC: Joining

- **Preceramic polymer: allylhydridopolysilane (aHPCS) + SiC powder**
  - **85 MPa average 4-point bend strength, RT**
- **ARCJointT: NASA developed, reaction formed SiC + other phases, applied in air with a torch- field application**
  - **134 MPa average 4-point bend strength, RT**
  - **247 MPa after anneal at 1100 C in air**
- **High-temperature brazes: Si-22%Ti: eutectic**
  - **60 MPa shear strength, RT**
- **Displacement reaction composite: Ti_xSi_yC + SiC**
  - **187 MPa 4-point bend strength, RT**
- **On-going work: PNNL working with aHPCS + SiC powder, preparation for irradiation in HFIR.**

SiC/SiC: Thermal Conductivity

- **Status:**
  - **Models developed that accurately predict behavior**
  - **Latest SiC/SiC with Type S: 26 W/m-K, highest to date for CVI matl.**
  - **Efforts to engineer higher thermal conductivity in progress:**
    34 W/m-K achieved.
  - **Irradiation will reduce value to 1/2 at 1000 C, goal is 20 W/m-K.**

- **On-going work:**
  - **Continue to measure thermal conductivity of advanced materials and check against models.**

- **Issues: effect of transmutants**