PFC Group Annual Meeting 2011 ORNL Aug 10-12

Summary: Heat Transfer Session

5 presentations plus discussion

- A new modeling approach applicable to He-cooled PFCs has a state-of-the-art treatment of fluid physics and conjugate heat transfer in a porous refractory foam and used a translation of format from x-ray tomography to generate an irregular solid. *(Youchison/Garde, Sandia; Wright/Williams, Ultramet)*
- A new modeling approach for hypervaportrons with full fluid physics for two-phase flow (water) can predict performance for the ITER FW and is benchmarked with US and Russian tests. *(Youchison/Ulrickson, Sandia; Bullock, Lamata)*
- Recent experiments at the U of I with a relatively modest B field show that the currents generated by the thermoelectric effect in lithium with a thermal gradient can move Li in a shallow trench at speeds of 15-22 cm/s. Applications for NSTX and HT-7 have been proposed and the Chinese will build a unit for HT-7. *(Ruzic et al., U of Illinois)*

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Continued

- UCLA Efforts on PFCs include joining of Be and F82H (PhD dissertion) , analyses of thermal-hydraulics and stress in ITER FW and shield modules, evaluation of jet impingement (like HEMJ) for He cooling of a FW (Masters Thesis), and revisiting flow of liquid metal free surfaces.
  (Ying et al., UCLA)
- 3-D thermal analysis of the LLD indicate that the thermal signature of the strike point broadens significantly due to the diffusion of heat laterally as well as downward in the highly conductive copper substrate. A parallel conclusion is that evaporation is neglible in this effect.
  (Nygren/Sceiford, Sandia) ionized Li.

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DISCUSSION

- Rob Goldston pointed out that there is also significant cooling in the plasma edge due to ionization. Jeff Brooks noted that this may be away from the divertor. Nygren noted that, while the radiative aspect of Li in the edge may be very helpful for the overall power distribution, the thermal analysis of the LLD deals with the direct heating of the LLD and losses for radiation and evaporation at the surface of the LLD.
- Nygren and Ulrickson noted the importance of convected power (and long secondary scrape-off-length) for FW heat loads and the problem this poses for ferritics that have low thermal conductivity, and further that a 1-mm-wall thickness (UCLA study) was unrealistic for a real structure.
- Discussion moved to the more general issue raised elsewhere of the uncertainty in power flow in the plasma edge.