

Solid Walls Session Summary

The Solid Walls topic was covered in three parts. The first session covered first wall and blanket applications of solid walls. Plasma facing component applications for solid walls were the topic of the second session. Opportunities for solid wall research were discussed in the final session. Approximately thirty people attended the sessions. A brief summary of the conclusions in the areas of first wall and blanket and plasma facing components follows.

First Wall and Blanket

An attractive fusion power system should incorporate high power conversion efficiency, the ability to accommodate high power densities, a low failure rate, the capability for faster maintenance and extended component lifetime, adequate tritium breeding, as well as exhibiting favorable safety and environmental features. Over the years, many design concepts have been studied, and they provide a starting point to estimate the power loading capability of solid first wall systems.

Key issues for first wall and blanket components include: a) high power density/power conversion capability, b) lifetime/reliability of solid wall/blanket systems, c) high temperature refractory metal alloy development, and d) insulator coatings needed for liquid metal systems, and e) solid breeder thermomechanical interactions. The following opportunities were identified during the sessions: 1) investigate the scientific foundations for innovative, high-performance systems through integrated design studies, 2) development of high temperature design code rules, 3) leverage access to international research with work on conventional systems, and 4) develop solid breeder materials with enhanced thermal properties. The key tasks identified over the next 10 years are a) validate fusion design code rules that provide enhanced power density capability, b) determine temperature limits for candidate materials, c) compatibility with coolants, and d) develop insulator coatings to reduce MHD pressure drop.

Plasma Facing Components

In the last five years the capability of plasma facing components has increased ten-fold and reliability has increased. This effort will continue to enable high-power-density long-pulse-length fusion devices for the near term. The addition of refractory metals and helium cooling capabilities will continue the usefulness of solid walls in future devices. Solid surfaces are a necessary alternative to liquid walls until those systems are proven.

Several key issues were identified in the plasma facing component session. Carbon based materials are unlikely extrapolate to fusion reactors or burning plasma devices because of tritium retention. Water cooling presents safety concerns for fusion energy (e.g., hydrogen generation, mobilization of activated materials due to interaction of water with hot surfaces,...). Heat removal capabilities need to improve to keep pace with fusion device performance advances. New refractory alloys (e.g., Mo and W with nano-particles of TiC added) that have improved thermal shock and radiation damage resistance can be applied to plasma facing components. We still have the opportunity to improve the heat removal capability of water (near term) and

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He gas cooled PFCs (long term) through the use of porous metals. The use of low-pressure liquid-metal cooling needs to be investigated. The joining and fabrication methods for refractory metals based PFCs needs to be developed (candidates include e-beam welding, friction stir welding and brazing). We need to take advantage of existing disruption facility to test new materials for both MFE and IFE.