Some Issues for the Development of Liquid Surface Fusion PFCs

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The plasma facing components or PFCs in a D-T component test device, DEMO or reactor PFCs include the divertor, a first wall (FW) plus any plasma facing structures necessary to protect the wall, such as poloidal limiters, or guards for launching structures. And many ideas for the application of liquid surface PFCs (LS PFCs) using Li (lithium) or other liquids (gallium, tin, tin-lithium or molten salts) have been proposed and new ideas are emerging. This presentation summarizes some of the information about the potential of robust LS PFCs with for applications in future D/T fusion device from a lengthy review paper being edited for publication. These PFCs have multiple functions and overlapping requirements. For example, the FW must be an integral structure with the tritium breeding blanket. And the PFCs must receive power exhausted from the plasma, transfer it to coolant that passes out of the vessel for heat rejection and, in a DEMO for power conversion, maintain structural integrity, retain tritium within safe levels, feedback only acceptable amount of impurities into the plasma, and provide a physical envelope that permits sustained confinement and adequate power production in the core plasma. Many ideas for LS PFCs are for divertors. FWs are likely to be more challenging technologically of the integral structure with the blanket. Maximum tolerable heat loads are a critical concern as is design integration with other subsystems. The presentation describes several processes at work in walls with fast-flowing or slow-flowing liquid plasma-facing surfaces, and the considerations imposed by heat transfer and the power balance for the PFC as well as the structure needed for an integrated first wall and blanket, plus some issues related to the R&D path and the restrictions for experiments in current magnetic confinement devices.

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