Abstract Submitted
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The Science and Technology Challenges of the Plasma-Material Interface for Magnetic Fusion Energy[1] DENNIS WHYTE, MIT - Plasma Science and Fusion Center — The boundary plasma and plasma-material interactions of magnetic fusion devices are reviewed. The boundary of magnetic confinement devices, from the high-temperature, collisionless pedestal through to the surrounding surfaces and the nearby cold high-density collisional plasmas, encompasses an enormous range of plasma and material physics, and their integrated coupling. Due to fundamental limits of material response the boundary will largely define the viability of future large MFE experiments (ITER) and reactors (e.g. ARIES designs). The fusion community faces an enormous knowledge deficit in stepping from present devices, and even ITER, towards fusion devices typical of that required for efficient energy production. This deficit will be bridged by improving our fundamental science understanding of this complex interface region. The research activities and gaps are reviewed and organized to three major axes of challenges: power density, plasma duration, and material temperature. The boundary can also be considered a multi-scale system of coupled plasma and material science regulated through the non-linear interface of the sheath. Measurement, theory and modeling across these scales are reviewed, with a particular emphasis on establishing the use dimensionless parameters to understand this complex system. Proposed technology and science innovations towards solving the PMI/boundary challenges will be examined.

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