Divertor Materials Evaluation System (DiMES)*

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Surface material erosion due to plasma-material interaction will limit the performance and lifetime of plasma facing components, particularly the divertor, where large incident particle and heat fluxes are expected. The mission of the Divertor Material Evaluation System (DiMES) is to provide basic materials erosion, and tritium up-take data resulting from the insertion and exposure of well-characterized material samples to tokamak divertor at DIII–D. These data, along with analyzed DIII–D divertor plasma diagnostic data, are also provided to plasma materials interaction modeling efforts to help benchmark these complex codes. These data are obtained during both normal, transient (e.g., ELMs) and off-normal (e.g., disruption) events. In addition, the DiMES system has been used as a test vehicle of different advance plasma facing materials (e.g., V-alloys and coatings) and as a carriage for the development of plasma diagnostics. It is becoming a versatile system that can be used to address many related technology issues. This paper will summarize some of these results. Materials of C, B_4C, SiC, B-doped graphite, and metal coatings of Be, W, V, and Mo, (~100 nm thick) were exposed to the steady-state outer strike point (ELMing and ELM-free H–mode discharges) on DIII–D for 5–15 s. These short exposure times ensure controlled exposure conditions and the extensive arrays of DIII–D divertor diagnostics provide a well-characterized plasma for modeling efforts. The rate of material erosion and tritium retention were measured. The measured net erosion rate for C at a heat flux of 2 MW/m^2 is substantial (16 nm/s) during ELMing H–mode that can be about 10 times higher than that projected by ITER. In addition, measured gross erosion rates of Be are lower than expected, most likely due to the heavy surface contamination by carbon. Under the carbon background, measured results show that the saturated deuterium areal density of Be is similar to C and about a factor of five higher than Mo and W coatings. The V metal, which is more relevant to fusion power plant design because of its low activation exhibits a deuterium areal density twice as high as for Be and C. Other results on disruption studies, exposure of fusion power plant relevant structural material V4Ti4Cr alloy and development of in-situ erosion measurements using colorimetry will be reported in this paper.

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