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Development of free-standing diffractive optical elements as light extractors for burning plasma experiments D. STUTMAN, G. CARAVELLI, M. FINKENTHAL, A. TOLEA, Johns Hopkins University, G. WRIGHT, University of Madison-Wisconsin, D. WHYTE, Massachusetts Institute of Technology, N. MOLDOVAN, Northwestern University — Optical diagnostics will be critical for the operation and performance assessment of burning plasma experiments, such as ITER. At the same time, extracting light for these diagnostics with reflective mirrors becomes difficult in the burning plasma environment, due to prolonged exposure to plasma and nuclear radiation. As an alternative, we explore free-standing diffractive optical elements, such as transmission gratings and zone plates. Since in the case of diffractive extractors the light is deflected by periodic slits rather than a surface, they may withstand plasma exposure with less degradation of their optical properties. To investigate this possibility we developed free-standing transmission gratings for the visible range and exposed them in to conditions resembling or exceeding those expected for the ITER 'first mirrors'. The results of this study indicate that the gratings can withstand high heat fluxes and plasma and energetic radiation bombardment. In addition, in contrast to the reflective elements, the extraction capabilities of the diffractive elements can also improve with plasma exposure, due for instance to shaping and thinning of the grating bars by plasma erosion. Work supported by US DoE grant DE-FG02-99ER54523.

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