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Comprehensive First Mirror Test for ITER at JET with ITER-like Wall

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Windows and first mirrors are essential plasma-facing components in all optical spectroscopy and imaging systems used for plasma diagnosis in a reactor-class machine. To recognize the extent of changes in the mirror performance a thorough First Mirror Test (FMT) has been carried out at the JET tokamak. The major goal is to assess the optical performance, and –by surface analyses –to determine causes of reflectivity changes. Up to date, FMT has been the most comprehensive study program of mirror behaviour in fusion environments. This paper summarises recent results from JET-ILW and provides a brief comparison to the operation with carbon walls (JET-C).
20 mirrors were exposed in JET-ILW for 18.9 h with 13.1 h of X-point operation. Divertor: Reflectivity of divertor mirrors was degraded by 50-85% because of the deposit formation: 60 –600 nm thick layers (in JET-C carbon deposits over 20 µm were formed). Be is the main element inco-deposits, the others are: D, C, N, O, inconel components and traces of W. Main Chamber Wall: The majority of Mo mirrors (7 out of 8) from the main wall retained high total reflectivity, i.e. the decrease was below 5%. The surface region (15-30 nm) of wall mirrors contained only light impurities. The results obtained so far for the main chamber mirrors allow some optimism regarding the reliability of diagnostics in ITER. To ensure the best possible predictions the FMT is continued in JET with the increased heating power. There is no doubt, however, that in ITER long-term exposure and off-normal events may change properties of the mirrors. A practical solution for maintaining high mirrors'performance in the main chamber diagnostics may be based on a periodic evaporation of a fresh Mo layer on the mirror surface. This approach can be applied in-situ and it is more realistic than photonic cleaning, protective filters, local plasma or gas puff or other methods critically assessed in Ref. [1].

[1] Rubel M et al 2009 J. Nucl. Mater. 390-391 1066

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