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ITR/P5-42: First studies of ITER diagnostic mirrors in a tokamak with all-metal interior: results of first mirror test in ASDEX Upgrade

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In ITER, mirrors will be used as plasma-viewing elements in all optical and laser diagnostics. In the harsh environment mirror performance will degrade hampering the operation of respective diagnostics. The most adverse effect on mirrors is caused by the deposition of impurities and it is expected that the most challenging situation will occur in the divertor. With envisaged changes to all-metal plasma-facing components (PFCs) in ITER, an assessment of mirror performance in the existing divertor tokamak with all-metal PFCs is urgently needed. Such an experiment was made in the ASDEX Upgrade with all-tungsten PFCs as proposed by the International Tokamak Physics Activity (ITPA) Topical Group on Diagnostics, supported by the Specialists Working Group on First Mirrors and carried out in the frame of collaboration between Forschungszentrum Jülich and IPP Garching.

Four molybdenum and four copper mirrors were mounted at the inner wall, in the dome facing the inner and outer divertor targets and in the pump-duct and exposed for seven months in ASDEX Upgrade. After exposure, degradation of the reflectivity was detected on all mirrors. The mirrors in the pump duct almost preserved their reflectivity unlike the mirrors in the dome facing the outer divertor which suffered from highest deposition and the strongest reflectivity degradation. Remarkably, only on the mirror facing the inner divertor and having very thin deposition layer of 15 nm, the carbon fraction was about 50 at.%. On all other mirrors this fraction did not exceed 20 at.%.

The exposure of diagnostic mirrors in the tokamak with all-metal PFCs demonstrated a positive trend to a reduction of net deposition and minor changes in the reflectivity of mirrors located in the pump-duct far away from divertor plasmas. However, the degradation of all exposed mirrors underlines the necessity of an active mirror recovery. Urgent R&D is needed to address the lifetime issues of mirrors in ITER divertor.

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Collaboration (if applicable, e.g., International Tokamak Physics Activities)

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