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**See Annex of J. Pamela et al., "Overview of Recent JET Results and Future Perspectives", Fusion Energy 2000 (Proc. 18th Int. Conf. Sorrento, 2000), IAEA, Vienna (2001).*

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INTRODUCTION

First mirrors will be the plasma facing components of optical diagnostic systems in ITER. Mirror surfaces will undergo modification caused by erosion and re-deposition processes [1,2]. As a consequence, the mirror performance may be changed and may deteriorate [3,4]. In the divertor region it may also be obscured by deposition [5-7]. The limited access to in-vessel components of ITER calls for testing the mirror materials in present day devices in order to gather information on the material damage and degradation of the mirror performance, i.e. reflectivity. A dedicated experimental programme, First Mirror Test (FMT), has been initiated at the JET tokamak and also at other controlled fusion devices: TEXTOR and Tore Supra.

1. EXPERIMENTAL PROGRAMME AT JET

The choice of JET for doing the FMT is related to several unique features of this machine: (a) a divertor tokamak with an ITER relevant configuration, (b) plasma pulses of 20s, (c) beryllium and tritium environment (d) comprehensive overview of erosion and deposition in a concurrent deposition monitoring activities. The programme aims at the study of morphology changes occurring on surfaces of selected mirror materials: polycrystalline molybdenum and stainless steel. FMT is included in the framework of Tritium Retention Studies (TRS), and this offers a comprehensive insight into erosion and re-deposition processes using a set of dedicated tools such as a quartz microbalance (QMB) [8] and other deposition monitors. Tested mirror samples will be installed in the vicinity of these devices.

Figure 1 exemplifies a design of an inconel cassette with several channels in which the mirrors are mounted. The number of channels in a cassette, three or five, is dependent on the available space in various locations of the machine: three positions in the divertor (inner, outer, base) and two on the main chamber wall.

The cassettes are of a “pan-pipes” shape and they are composed of two detachable plates. The construction enables studies of deposition both inside the pan-pipes channels and on the mirror surfaces. Moreover, the exposure of mirror surfaces at various inclination angles and aspect ratio with respect to plasma is possible. Effects of sample temperature on deposition in the divertor may be studied by comparison with the QMB data. Fig.2 shows the location of the mirrors and other deposition monitors in the divertor base and the inner carrier. The arrangement of devices in the outer divertor is similar to that in the inner leg (see Fig.2(c)). There are also cassettes placed on the main chamber wall protected by magnetic shutters which open when the magnetic field is on. This ensures avoiding the deposition of beryllium during its evaporation on the JET wall. Installation of all the deposition monitoring devices in the JET vessel is compatible with remote handling [9]. The construction phase and commissioning of the diagnostic tools for TRS (including FMT) is to be ready for installation in 2004. The experiment itself will be carried out for approximately two years. This relatively long “response” time before the mirrors will be available for ex-situ studies by means of surface analysis and optical methods encourages mirror experiments to be also carried out in other machines, like TEXTOR (limiter tokamak with circular plasma), where some specific questions can be addressed.

2. EXPERIMENTAL PROGRAMME AT TEXTOR

At the TEXTOR tokamak there are three systems, equipped with shutters, for a controlled transfer and positioning of various types of material specimens (e.g. shape, size, weight) in the Scrape-Off Layer (SOL). So-called limiter locks are located in the top and the bottom of the machine, whereas the transfer system of a collector probe is operated in the equatorial plane on the low field side. All of them offer large flexibility in controlling the exposure conditions: distance from the plasma, exposure time, plasma operation scenario. Two of those systems will be used for exposure of the mirrors. Figure 3 shows an experimental set-up with a "roof-like" limiter [10,11] inserted into the torus from the top of the machine. A polycrystalline molybdenum plate (6×10 cm^2) is mounted on a graphite block inclined by 20^o with respect to the magnetic field lines. This allows for the determination of radial effects of erosion and deposition on mirror surfaces. Moreover, the plate will be monitored in-situ during the exposure by means of spectroscopy. The experimental programme will be broadened using the collector probe system fitted with a tube-like head in which a set of mirrors and a window (at the end of the tube) can be mounted. Therefore, the design will resemble a diagnostic port for plasma spectroscopy.

The major advantage of the experimental set-up being prepared at TEXTOR is related to the flexibility of the systems allowing for a quick exchange of samples. Possible influence of beryllium on the performance of mirrors can not be studied in this machine. However, the experiments assure a short response time between the exposure and ex-situ examination of mirrors with surface analysis and optical methods.

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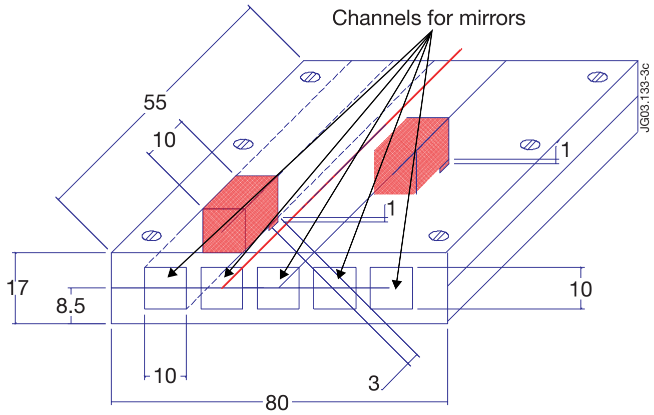

Figure 1: A schematic view of a cassette for the mirrors tested in JET

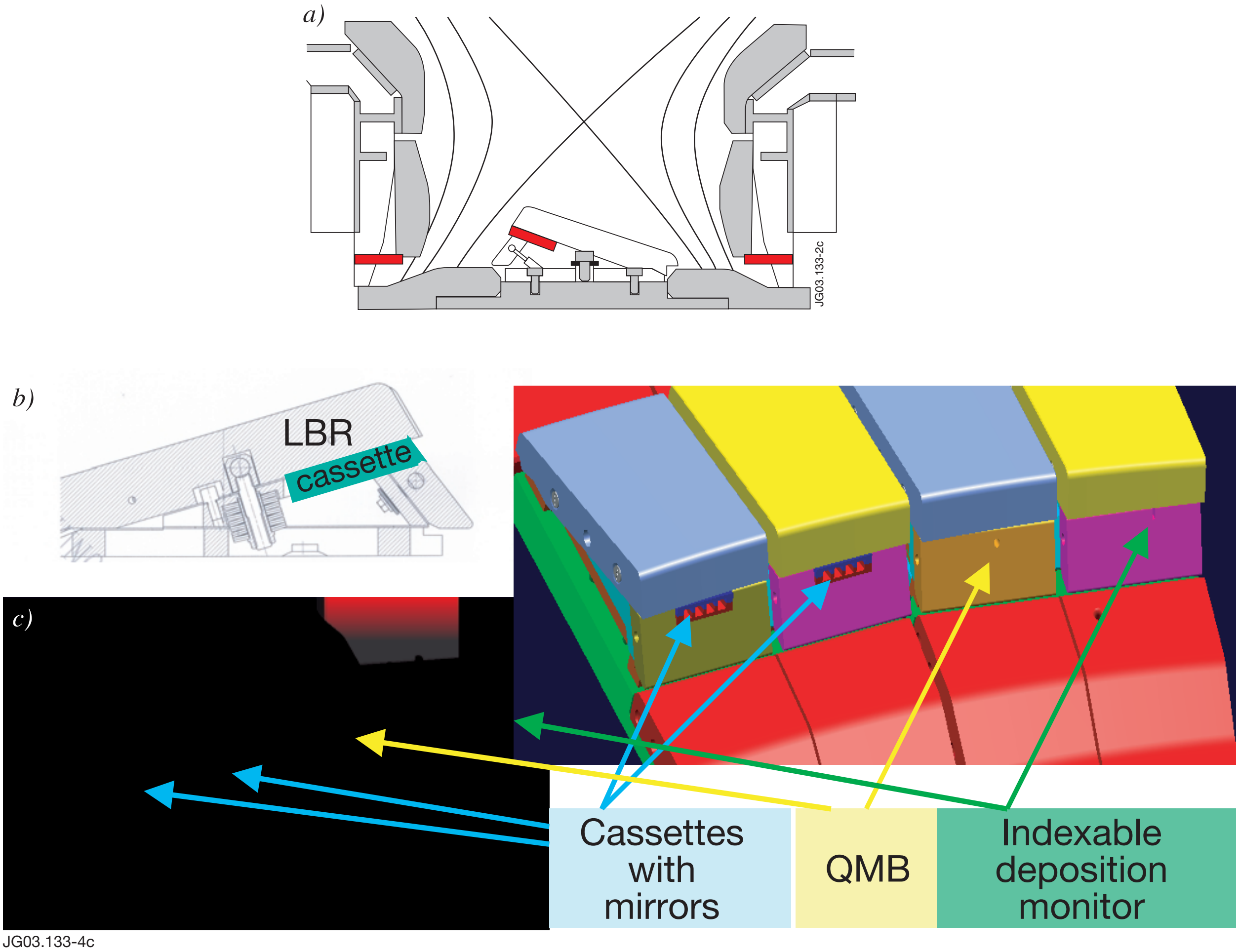

Figure 2: (a) Divertor cross-section with a mirror cassettes (green boxes) in the inner and the outer carrier and below the load bearing plate (LBR made of carbon fibre composite); (b) base divertor module with a cassette; (c) location of several devices for monitoring the deposition mounted in the base divertor modules [LBR removed].

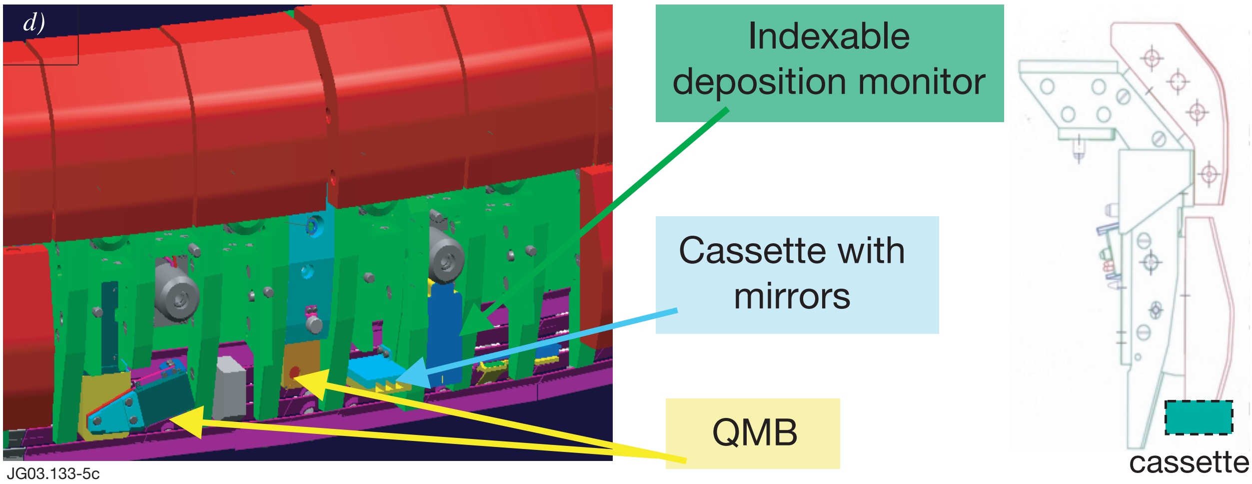

Figure 2: (d) Location of tested mirror and other deposition monitors in the inner divertor

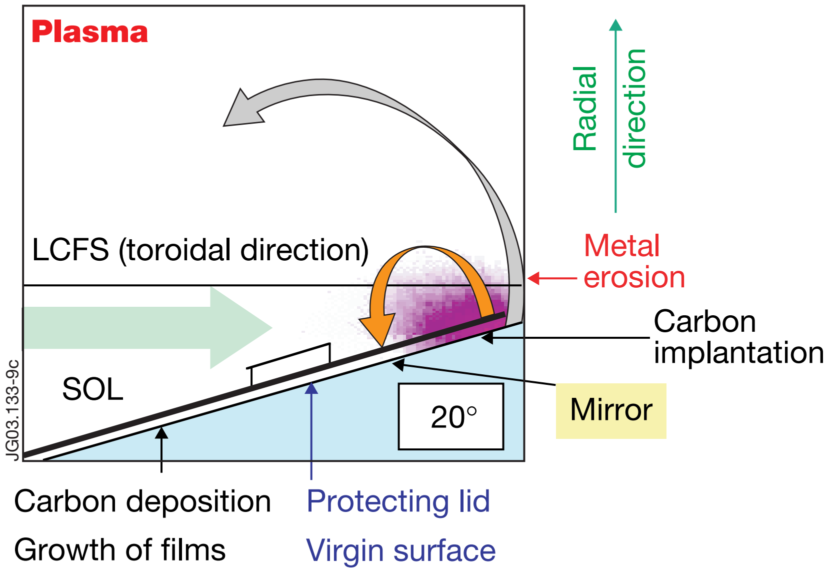

Figure 3. Experimental set-up for mirror exposures at the TEXTOR tokamak. Mirrors are mounted on an plate placed in the SOL and inclined by 20^o with respect to flux.