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# EX/P5-24: Power Handling of the Tungsten Divertor in JET

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With incident power densities of 5-10MW/mˆ2 or locally even higher, divertor target plates of large tokamaks are driven close to the material limits. The power handling performance is essential to their characterisation. The thermal performance of tungsten is critical to the decision as to whether to start ITER with an all tungsten divertor. In the new ITER-like Wall in JET, the divertor tiles consist of carbon-fibre composites coated with tungsten except for a specific row within the range of the outer strike point where bulk tungsten is used.
The multilayer coating (Mo/W) is 12-25um thick depending on the poloidal position. Ion beam tests have shown that the risk of delamination is low (<1% area) as long as the coating is maintained below 1200℃ and carbidisation is negligible. The tiles are coated by combined magnetron sputtering and ion implantation (CMSII-discharges in argon). The resulting Ar content of the layers (<2% at.) is seen in spectroscopic traces. W-radiation events were spectroscopically observed which correspond to particles penetrating the main plasma (equiv. diameters around 100um). The number of events has decreased with time. Regular inspections have not revealed any definitive evidence of delamination.
The bulk tungsten row consists of 48 tile assemblies. Each one is made of two sets of four stacks of 24 lamellae. The stacks are aligned with the toroidal direction. To minimise the risk of fracture, the brittle tungsten is subjected by the clamping to compression forces only. The surface temperature is currently limited to 1200℃ to avoid appreciable grain growth and possible thermo-mechanical fatigue (T_observed<900℃ at the time of writing). Later, the upper bound will be set to 2200℃ (a limit on the power density) and, for the deposited energy density per pulse, to 54MJ/mˆ2. Taking advantage of the segmentation of the tiles, sweeping over two stacks is effective for spreading out the load down to acceptable levels.
Loads in the order of 25MJ/mˆ2 were reached so far. The modelled temperature rise of the plasma-facing tungsten shows a fair agreement with the records of thermocouples and of infrared cameras and pyrometers which are sensitively dependent on the emissivity (0.18-0.6). The experimental behaviour is close to design values in a wide range of operational parameters.

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