Recent developments in the design of the actual ITER CVD diamond torus window assembly

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Abstract

The development of artificial diamond disks, fabricated by special CVD processes, lead to a new generation of high power millimetre wave window units with extremely low absorption and scattering losses for high power transmission. A reduction of the loss tangent by CVD diamond surface engineering could qualify diamond for higher power applications in future fusion projects (e. g. DEMO) with more than 2 MW transmitted microwave power through a window unit. Up to now 1-2 MW is typically the power for the ITER fusion device. By means of physical analysis of artificially modified surfaces (e. g. electrical conductivity, contact angle measurement, polar and non-polar surface energy, Raman spectroscopy and surface microwave absorption measurements) the influence of the atomic surface finish to the microwave losses will be discussed on base of a H-, O- terminated diamond surface and as well of passivated diamond (SiO, AlN). To avoid a reaction of Tritium, which is necessary in the fusion device, with the diamond surface during fusion operation phase, a passivation layer for the diamond could be an important tool to protect the diamond disk against additionally absorbed heating power.
The new design of the ITER torus window prototype III is now optimized by means of thermal, structural and pressure analysis/simulation and will be presented in the actual status taking safety aspects into account.
The presented work shows also a first approach towards broadband windows aiming towards a frequency tuneable EC heating and current drive system for plasma reactors.

Possible Collaborations:

Window development for equatorial and upper Launcher JAEA / Naka (Japan)