Contribution ID: **32**

Type: **Poster**

EX/P5-03: Assessment of Tungsten Nano-tendril Growth in the Alcator C-Mod Divertor

Thursday, 11 October 2012 08:30 (4 hours)

The conditions for the growth of tungsten (W) or molybdenum (Mo) nano-tendrils have been well defined in linear plasma devices (helium plasma, Tsurface > 1000 K, E_He+> 20 eV). We have exploited the high power density in Alcator C-Mod to successfully grow W nano-tendrils on a Langmuir probe (ramped approximately 11 degrees into the parallel plasma flux) in the lower divertor during a single run day, demonstrating for the first time that these nano-tendril structures can be grown in a tokamak divertor. Scanning electron microscopy and focused ion beam cross-sectioning shows a 600 +/- 150 nm thick nano-tendril layer on the surface of the W Langmuir probe after approximately 15 seconds of accumulated growth time. This layer thickness is in agreement with calculations using a preliminary empirical growth formula proposed by Baldwin et al. [1]. The W nano-tendrils show no sign of melting despite receiving surface heat fluxes of approximately 35 MW/mˆ2 and three full current (900 kA) plasma disruptions during the growth sequence. There is also no indication of unipolar arcing from the nano-tendrils. Sputtering calculations show that sputtering is playing a minor role in nano-tendril growth on the W surfaces. However, strong sputtering is likely inhibiting nano-tendril growth on nearby Mo surfaces that received heat fluxes of 10 MW/mˆ2 and achieved surface temperatures >1000 K but showed no indications of nano-tendril growth. Having shown that these nano-tendrils can form in a tokamak divertor and given that the key growth conditions are met in an all-W ITER divertor during operation in He or the DT phase, there is a strong need to understand how other plasma conditions not re-created in this work, such as ELMs and impurity seeding, can affect growth and how these nano-tendril layers can impact plasma-material interactions and tokamak operations.
This work is supported by US DOE award DE-SC00-02060 and US DOE contract DE-FC02-99ER54512.
[1] M.J. Baldwin, R.P. Doerner, Nucl. Fusion 48 (2008) 035001.

Country or International Organization of Primary Author

United States

Primary author: Mr WRIGHT, Graham (Massachusetts Institute of Technology)

Co-authors: LABOMBARD, Brian (Massachusetts Institute of Technology); LIPSCHULTZ, Bruce (Massachusetts Institute of Technology); BRUNNER, Daniel (Massachusetts Institute of Technology); WHYTE, Dennis (Massachusetts Institute of Technology); TERRY, Jim (Massachusetts Institute of Technology); BALDWIN, Matthew (University of California-San Diego); DOERNER, Russ (University of California-San Diego)

Presenter: Mr WRIGHT, Graham (Massachusetts Institute of Technology)

Session Classification: Poster: P5

Track Classification: EXD - Magnetic Confinement Experiments: Plasma–material interactions; divertors; limiters; scrape-off layer (SOL)