TOPIC: EX-D

Deposition and Dust studies in NSTX

C.H. Skinner [1], J. Hogan[2], H.W. Kugel [1], A. L. Roquemore[1], W. R. Wampler[3], C. V. Parker[4], C. Voinier[5].
(email: cskinner@pppl.gov)

[1]*Princeton Plasma Physics Laboratory, P. O. Box 451, Princeton, NJ 08543 USA*
[2]*Oak Ridge National Laboratory, Oak Ridge, TN 37831, USA*
[3]*Sandia National Laboratory Albuquerque, NM 87185*
[4]*Harvey Mudd College, Claremont, CA, 91711*
[5]*The College of New Jersey, Ewing, NJ, 08628 USA*

Abstract:

Tritium retention, dust and deposition on diagnostic mirrors will impact the operation of next-step devices such as ITER. Hence, measurements in contemporary tokamaks are important to gain a predictive understanding that can help to mitigate the associated risk. Quartz crystal microbalances (qmb) have been deployed in NSTX to measure pulse-by-pulse deposition and erosion at the upper & lower divertor and outboard midplane and the deposited layer thickness was recorded continuously throughout the 2005 campaign. Typically ~1 nm of deposition is observed on the first discharge of the day followed by a complex pattern of erosion or deposition on subsequent discharges. The scale of the interaction increases with the proximity of the plasma to the qmb's. We will present data on the correlation of erosion / deposition with pulse duration, stored energy and other plasma parameters. Nuclear reaction analysis showed the average atomic composition of the deposited material remaining on the qmb's after the campaign to be ~58% carbon, ~27% deuterium and ~15% boron. Dust particles are ubiquitous on the interior surfaces of current tokamaks and the more intense plasma surface interactions and longer pulse duration in next-step devices such as ITER is expected to lead to much higher accumulations of dust. These dust particles will be radioactive from tritium or activated metals, toxic and/or chemically active with steam or air and the inventory of dust will be strictly limited to avoid adverse safety consequences. Methods to measure the inventory of dust particles and to remove dust if it approaches safety limits will be required. A novel electrostatic dust detector, based on fine grids of interlocking circuit traces, biased to 30 or 50 v, has been developed for the detection of dust on remote surfaces in air and vacuum environments. Laboratory experiments showed that impinging dust particles from carbon tiles create a short circuit. The resulting current pulse is analyzed by nuclear counting electronics and the number of counts is correlated with the mass of dust landing on the grid. The short circuit events are transient as heating by the current pulse caused up to 90% of the particles to be ejected from the grid or vaporized.
Work supported by U.S. DOE contract DE-AC02-76CH03073