Contribution ID: **122** Type: **Poster**

FTP/P1-03: Temporal and Spatial Evolution of In-vessel Dust Characteristics in KSTAR and Dust Removal Experiments in TReD

Tuesday, 9 October 2012 08:30 (4 hours)

Visible CCD images from 2010 and 2011 campaigns were analyzed by using image analysis technique. It is found that limiter machine like Tore Supra (TS) has main localized origins as well as many random dust creation events while divertor machines like ASDEX Upgrade (AUG) and KSTAR have origins localized mainly at divertor. The number of dust creation event per second (DCEs; dust creation frequency) is large in both machine configuration just after the machine restart, and decreases as a function of time during the machine conditioning. In TS, DCEs were in a range between 3-6/s while that in divertor machines AUG and KSTAR are between 0.5-4.
Dust velocity distribution in 2010 and 2011 campaign was evaluated by using a dedicated software. Only "well defined dust trajectories" at in-board side are considered. Dust velocity is in the range of 10-400m/s with peak velocities of 30 and 50m/s respectively. It is observed that metal dusts created by runaway electron impact have much faster velocity, probably hypervelocity.
Short term (daily) and long term (campaign integrated) dust samples were collected and analyzed. Statistics on short term dust samples indicates that the dusts are getting more and more smaller and rounded as a function of time. Most of dusts collected by short term based method are carbon-based materials. Average particle flux is ~1.2×10^4 part/cm2/s and it decreases slightly as a function of plasma operation time. Most of dusts have effective radius in the range between 0.075-3μm, peak@ 0.115μm. Total mass of dusts (extrapolated with area of mid-plane) during the analyzed period is ~122mg (average ~7mg/day, ~0.072μg/cm2). Dusts from long term campaign integrated samples are large size broken graphite pieces, stainless steel, copper, etc. Various shapes and flake-like dusts are observed. Areal distribution of dusts is from 0.43-1701μm^2 (peak at ~2μm^2), and average flux of ~3.48 part/cm^2/s is obtained (~10 part/cm^2/s in AUG). The mass difference of silicon wafer between before and after the dust collection was 0.1±0.05mg on 6.78 cm^2(14.8μg/cm^2). Extrapolate the amount of dusts using the area under the divertor(~3.38m2), 497 mg would be present(~9.6mg/day).
The transportation efficiency of Al2O3 dusts in He glow discharge in TReD machine was ~10-15% (injected vs collected). Currently, dust removal rate is obtained as ~10mg/h.

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Session Classification: Poster: P1

Track Classification: FTP - Fusion Technology and Power Plant Design