Laser photo-detachment method for dust charging and density measurements

S.H Lee[1], H.T. Oh[1], M.-K Bae[1], I.J Kang[1], I.S. Park[1], S.J Jeong[1], K.-S. Chung[1]

[1] *Department of Electrical Engineering, Hanyang University, Seoul, South of Korea*

Dusts in the size of 10 nm – 100 μm could be generated due to plasma surface interactions in tokamak devices. During tokamak operation, these dusts could cause power loss through Bremsstrahlung radiation and affect plasma performance. Therefore, measuring the exact density of dusts is important for fusion research. In this experiment, the methods used for negative ion measurements are to be applied to dust measurements. Available methods for measuring the density of negative ion are utilized: LPD (Laser photo-detachment method) [1], electric probe method. In this experiment, plasma was generated by DC filamented source in a cubic chamber device called CPD ($24 \times 24 \times 24$ cm^3). Specifications of laser are as the following: Nd:YAG laser , energy = 250 mJ, repetition rate = 2 ~ 20 Hz, pulse width = 10 ns. An electric probe is located at center of CPD for receiving LPD signal, where laser beam path passes. Laser screening object is installed in front of CPD for reducing ablation effect of electric probe due to direct impact of laser [2].

To verify validity of LPD, negative ion densities in plasma would be deduced by measuring relative photo-detachment signal, which are to be compared with those measured by electric probe method and same process are repeated in different gas pressure ratio of O_2 to Ar. In probe method, one large planar probe and one cylindrical probe have been used for the direct deduction of negative ion density [3] and dust charging. Tungsten dusts are to be introduced for the measurement of dust charging and density by electric probes and LPD. The effect of tungsten dust on plasma parameters is also measured. The dust temperature is also roughly estimated through the relaxation of LPD signal. By comparing both the negative ion measurement and the dust measurement, we could get more reliable measurement of dusts in terms of charging and density measurement.

References:

[1] M. Bacal, Rev. Sci. Instrum. 71 (2000) 3981.

[2] K.-S. Chung and S. Kado, Phys. of Plasmas. 13 (2006) 104509.

[3] S. Kajita, S. Kado, A. Okamoto and S. Tanaka, Phys. Rev. E 70 (2004) 066403.