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Cesium recycling in the large cesiated negative ion source toward JT-60SA and ITER

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As the negative ion source for neutral beam injection in JT-60SA and ITER, a large cesiated negative ion sources have been designed to produce the high current beams of > 20 A from an ion extraction area of > 45 cm x 110 cm. In order to maintain the high current beam production, cesium (Cs) is continuously injected to enhance the surface production of negative ions on the plasma grid (PG). In this case, Cs recycling such as high Cs consumption and long conditioning phase is one of the critical issues. Therefore, it is important to clarify physics of the Cs recycling in the negative ion source. As the first step, time evolution of spatial profile of negative ion production during an initial conditioning phase has been experimentally investigated in the JT-60 negative ion source, where a Cs nozzle is installed in the center of the negative ion source and negative ions are extracted from the PG (45 cm x 110 cm). Up to 0.4 g Cs injection, there is no enhancement of the negative ion production and no observation of the Cs emission signal in the source, suggesting the injected Cs is mainly deposited on the water-cooled wall near the nozzle. After 0.4 g Cs injection, enhancement of the negative ion production appeared only at the central segment of the PG. The calculation of the Cs neutral/ion trajectories implied that a part of Cs was ionized near the nozzle and was transported to this area. The expansion of the area of the surface production was saturated after ~2 g Cs injection corresponding to ~6 x 10^3 s discharge time. From the results, it is found that Cs ionization and its transport plays an important role for the negative ion production.