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Optimization of the Cesiation Process for the SNS H^- Ion Sources

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Cs-enhanced, RF-driven (internal or external antenna) H^- ion sources are used to produce high current (>60 mA), high duty-factor (1 ms, 60 Hz) H^- beams for the accelerators at the Spallation Neutron Source (SNS) facility. A solid reaction Cs dispenser system placed near the ion source outlet, the Cs collar embedded with cartridges containing a mixture of Cs chromate and St101 getter material, is used to cesiate the ion source. When the Cs collar is heated to ˜550 ℃, the chromate reacts with the getter and releases elemental Cs. A newly installed ion source undergoes a plasma conditioning process, which is to outgas and sputter clean the chamber and internal components. To effectively outgas the Cs collar, the collar temperature is kept at ˜250 ℃ (higher than typical operation temperature of ˜200 ℃ but far below the cesiation temperature) during the plasma conditioning. After fully conditioning the chamber, a cesiation at ˜550 ℃ is conducted to ready the ion source for beam delivery. While every ion source startup follows the same conditioning and cesiation procedure, variations in the amount of released Cs observed with plasma emission spectroscopy are often recorded. In some cases, a significant amount of Cs release was observed even during the plasma conditioning phase. Excessive Cs can cause severe sparking in the extraction region and the electrostatic beam transport section. This paper will present the optimization studies of the ion source conditioning and cesiation process guided by the Cs signal in the plasma emission spectroscopy. The studies include reducing the Cs collar temperature during the plasma conditioning, skipping the step of cesiation at ˜550 ℃ if the Cs presence is significant during the plasma conditioning, and experimenting with the temperature and duration of cesiation.

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