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# Concept for a Cesium-Free Negative Ion Source based on Microwave Heating of a Low Work Function Granular Material

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The negative ion source most commonly used in AMS systems is the cesium sputter type. Cesium is hazardous, making its handling not easy. Recently, the spread of compact AMS systems with acceleration voltages of 500 kV or less has been progressing. For the widespread adoption of AMS systems, it is desirable for the ion source to not only be highly efficient but also cesium-free from the perspectives of safety and maintenance. We propose a concept for a high efficiency cesium-free negative ion source based on microwave heating of granular low work function materials.

The proposed negative ion source features a structure where the plasma region and the negative ion generation region are adjacent within a microwave cavity. The negative ion generation region contains a mixture of low-temperature plasma and low work function material in granular form heated by a microwave. Typical low work function materials have a certain level of conductivity, making it difficult to directly heat their bulk state (e.g., plate, rod, and etc.) with the microwave. However, when the material is in a granular state, the aggregate of those granules can be volumetrically heated by microwaves. Sample gas that enters the plasma region becomes ionized and excited. The excited atoms and molecules then enter the negative ion generation region, coming into contact with the heated surface of the low work function material, transforming into negative ions that are ultimately drawn out by an electric field. This negative ion source concept is expected to offer the following advantages: (i) Since the low work function material is in granular state, the contact area with excited atoms and molecules is more than ten times larger compared to conventional cesium-free ion sources using low work function materials. (ii) Since the plasma region and the negative ion generation region are clearly separated, loss of negative ions due to electron impact can be reduced. (iii) In the plasma region, interfering isobars such as $^{13}$CH in $^{14}$C measurements can be dissociated to some extent.

Currently, the assembly of the test bench is nearly complete. Future work will involve progressing with the proof-of-concept testing.

## Student Submission

No

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