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A gauge for the amount and condition of the cesium in the reservoir of the cesium sputter source

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The most common ion source of AMS instruments, the cesium sputter source (Middleton 1983), demands a substantial share of the regular maintenance work and causes a considerable number of operation interruptions. One reason is the difficulty of obtaining meaningful diagnostic measurements under the rough conditions inside. In addition to the high temperature and the strong electric fields, the hot cesium vapor degrades and shortcuts insulators and blinds viewports. Too much cesium in the source can look like too little, and an oversupply will shorten service life or cause immediate failure.
Cesium is also prone to oxidation by atmosphere or moisture entering the vacuum system. Oxidized cesium does not vaporize, and additionally can form thin crusts on cesium metal, which block its evaporation. An ion source yielding low currents without obvious reason is a frequently observed phenomenon, which is usually targeted by trial and error, including risky procedures like “cesium cracking”.
We have developed a device which allows us to diagnose one possible cause, the depletion or degradation of the cesium in the reservoir of the source. The cylindrical body of the reservoir, machined of a single piece of stainless steel, folds in at the bottom where a ferrite rod is inserted. The cesium metal forms a ring around this insertion, and acts as the secondary winding of an electrical transformer. The conductivity of this ring determines the impedance of the outside primary coil. The method is indicative for both exhausted or oxidized cesium.
Our prototype measures the impedance using an active rectifier at a fixed frequency. The electronics are only connected for a measurement when the ion source is off during changes of the sample magazine. The device has been in use now for several years at the VERA facility. We will present the method development and discuss the performance and limitations. We think that such diagnostics will be useful for other facilities also and share the engineering sources under the CERN-OHL-P license.

R. Middleton, A versatile high intensity negative ion source, Nucl. Instrum. Methods Phys. Res. 214, 139–150 (1983).

Student Submission

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