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Additively manufactured tantalum cathode for FEBIAD type ion sources: production, geometric measurements, and high temperature test

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The Laser Powder Bed Fusion (LPBF) is an AM technology suitable to produce almost free-form metallic components. At Legnaro National Laboratories of the Italian National Institute for Nuclear Physics, the LPBF process was recently used to produce parts of the Forced Electron Beam Induced Arc Discharge (FEBIAD) ion source for the SPES Isotope Separation On-Line (ISOL) facility.
Such device is a critical component for the ISOL process, as its correct functioning is fundamental to ensure the availability of the radioactive ion beam to the experimental users. One of the main parts of the ion source is the tantalum cathode, a component that is electrically heated up to 2200℃ and is subjected to thermal stresses. Currently, the cathode is produced by subtractive manufacturing processes and TIG welding, which are not trivial in the case of Tantalum. Therefore, the cathode lacks dimensional/geometrical precision, affecting the performance repeatability and reliability of the ion source.
The LPBF technology allows to perform a morphological/topological optimization of the cathode aiming to overcome the intrinsic assembly limits of the present design and making more repeatable and reliable the ion source performance.
In this work, the production of the prototypical cathodes via AM, the results of dimensional–geometrical measurements, and the endurance high-temperature test are presented.

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Primary author: BALLAN, Michele (Istituto Nazionale di Fisica Nucleare)

Co-authors: PEPATO, Adriano (Univ. degli Studi di Padova); GIROTTO, Alberto (Università di Brescia); MONETTI, Alberto (Istituto Nazionale di Fisica Nucleare); PADERNO, Diego (Istituto Nazionale di Fisica Nucleare); BODINI, Ileana (Istituto Nazionale di Fisica Nucleare); MANZOLARO, Mattia (Istituto Nazionale di Fisica Nucleare); REBESAN, Pietro (INFN- Sez. di Padova); DIMA, Razvan (INFN- Sez. di Padova); CORRADETTI, Stefano (Istituto Nazionale di Fisica Nucleare); VILLA, Valerio (Istituto Nazionale di Fisica Nucleare)

Presenters: BALLAN, Michele (Istituto Nazionale di Fisica Nucleare); REBESAN, Pietro (INFN- Sez. di Padova)

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