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Development of Copper Vacuum Chambers via Electroforming Process for Use in Synchrotron Accelerators

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New upgrades in synchrotron accelerators require the utilization of vacuum chambers with extremely small apertures. The reduced cross-sectional areas of these vacuum chambers have a significant impact on the vacuum system due to decreased conductance of the vacuum tube. An approach employing distributed pumping, such as getter coating, is imperative to maintain low pressure. Physical vapor deposition techniques (Non-Evaporable Getter - NEG), based on the principle of metallic surface sorption of gas molecules, help to establish and maintain vacuums by soaking up or bonding to gas molecules that remain within a partial vacuum. They are important tools for improving the performance of many vacuum systems. PVD coatings are challenging to apply to indefinitely small pipe diameters (limited to 10 mm), primarily due to constraints on cathode space and difficulties in maintaining stable plasma. This study evaluates a potential solution to this issue through the manufacturing of a complete NEG coated vacuum chamber by electroforming. The vacuum chamber is fabricated of copper around a sacrificial aluminum mandrel, pre-coated with a thin NEG film. Following the film growth phase, the aluminum mandrel is removed, using alkaline solution, resulting in the formation of the chamber. Validation trials of this process were conducted using both flat and tubular samples, which were characterized using optical microscopy, Scanning Electron Microscopy, and EDS techniques. The results are presented in the current study.