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Dual Closed Field Bias HiPIMS deposition of nanometer periodicity metal multilayers for complex shape Accelerating Structures

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To boost the performance of pulsed GHz X-band Linacs, accelerating gradients higher than 100MV/m and the highest electrical breakdown reliability must be achieved. Reliability studies indicate that surface fatigue due to pulsed heating and to the related physical phenomena involved in metallic surfaces submitted to very high fields are the cause electrical breakdown. Although considerable improvements have been obtained by using Cu, Cu-alloys and other bulk materials in the development of these structures, the use of PVD to obtain nano-structured engineered surfaces on the inside of these small-sized cavities is not reported. As a matter of facts, being the size of these accelerating cavities of order of few centimeters, it is impossible to deposit a coating from inside. To overcome this problem sacrificial negative shape mandrels are PVD coated and then chemically dissolved after electroforming. The shape of the rotationally symmetric mandrels is characterized by grooves with vertical walls and aspect ratios in the range 4 to 5. In order to control the deposition process, bias ionized sputtering has been chosen as the deposition technique. Homogeneous bimetallic compounds as well as nanometric period multilayer coatings are obtained with the dual Closed Field HiPIMS system designed at the Legnaro National Laboratories (LNL). Negative DC Bias is applied to the mandrels during HiPIMS deposition through an ad hoc designed electrical circuit. This paper will describe the results of the successful deposition onto the mandrels of metallic Cu/Mo multilayers with periods in the nanometer range. Deposition profiles along the vertical walls and on the bottom of the trenches are determined by α-particle EBS and by STM as a function of bias. The electrical parameters of the HiPIMS plasma and the electrical pick-up on the sample are discussed together with the optical emission from the plasma pulses.

Keywords
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