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Design, fabrication and mechanical tests of TIG-welded Ka-band accelerating structures for ultra-high gradient applications

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The investigation of the processes, materials, technology and welding procedures used to manufacture accelerating components for maximum accelerating gradient (>100 MV/m) and minimum RF breakdown probability has led us to the proposal of hard-copper structures in Ka-Band made of multiple parts.
In this paper, we illustrate the TIG welding tests, including visual inspection and temperature monitoring, of Ka-band metallic RF cavities for the cases of two-half and four-quadrant models.
The RF cavities made of multiple parts operate at ultra-high accelerating gradients (well above >100 MV/m). Therefore, the following aspects of the welding procedure were used as references for the positive outcome of the process: 1) Successful execution of each weld bead/seam in order to assure vacuum tightness of the cavity. 2) The cleanliness of the inside surfaces of the cavities: visual inspection for absence of oxidation after cutting the cavity samples; 3) The temperature of the cavity surfaces always below the annealing one (mechanical properties significantly change after heating above 590 ◦C), in order to keep the hardness of the copper.

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