Seminar

Institute for Plasma Research

Title : Determination of Residual Stresses in Ceramic-Metal Brazed Joint Using FEA and Experimental Validation of the Results

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Date : 21st August 2020 (Friday)

Time : 10:45 AM

Venue : Online - Join the talk on Microsoft Teams (Use Google Chrome or Microsoft Edge browser, it doesn't require any login)

Abstract :

Ceramic vacuum feedthroughs are the inevitable requirement for the systems subject to high vacuum, high radiation and high voltage environment, which requires electrical feedlines to be inserted through vacuum vessel. These feedthroughs consist of metal-ceramic transition. Due to such transition, feedthroughs require brazing process as a joining technique. This process allows joining two base materials, i.e. Alumina and Kovar for this case, which manifests different thermo-mechanical response. This difference of Coefficient of Thermal Expansions (CTEs) of these materials causes the development of residual stresses in the cooling phase of the brazing job. These residual stresses, if not addressed properly, can lead to the failure in the brazed joint even before the design limits.

The present study focuses on the calculation of the residual stresses to identify the thermo-mechanical response in the Alumina-Kovar brazed assembly utilizing the Finite Element Method (FEM). To establish a method for analyzing the residual stresses in the brazed joint using FEM, ANSYS, a general-purpose finite element code, is utilized. Non-linear aspect of the analysis is an important consideration for the analysis to get the realistic results. Temperature-dependent CTEs of materials and plastic deformation (hardening) data of the braze material are considered for the FE analysis as stress relaxation in the brazed joint takes place due to plastic deformation of braze alloy.

Further, X-Ray Diffraction (XRD) based residual stress measurement technique has been utilized to validate the FEA results of the small sample for benchmarking the results which is an important aspect of this study as this will allow to use the same methodology for the other configurations of the ceramic feedthroughs without the need of further experimental test which is time consuming. The work describes the FEA methodology (model, non-linear material properties, boundary conditions, results, etc.) followed by the experimental results and their comparison.