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Mechanical Strength Evaluation of Superconducting Magnet Structure by HIP Bonding Method

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At the previous international conference HIP '14 it was suggested that the HIP method for the fabrication of the radial plate segment, which is the structure for supporting the toroidal magnetic field coil of ITER, be used.
The purpose of this suggestion was to improve the material yield and reduce the time spent on the machining process.
In order to verify that a uniform HIP effect for a large structure, a mock-up was fabricated using diffusion bonding method.
Mechanical strength tests were performed at both room temperature and cryogenic temperature on various locations of the mock-up.
The yield strength of the bonded area was about 920 MPa at 4 K (kelvin), and it was approximately the same yield strength as the base material after HIP treatment.
However, yield strength of the base material was reduced due to heat input, decreasing by 28% at room temperature and by 8% at 4 K, comparing before and after HIP treatment.
In order to apply HIP bonding for fabrication of each part, it is necessary to obtain the optimal parameters, to achieve the best results for the bonded area and the base material.
Focusing on the HIP bonding temperature as a parameter for determining the optimal conditions for diffusion bonding, small test pieces were bonded at various temperatures by HIP treatment.
From the results of the mechanical strength and micro structure analysis of the bonded area, the optimization of the bonding condition can be estimated.

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