Reduced activation ferritic/martensitic steels (RAFMs) are recognized as the primary candidate structural materials for fusion blanket systems as it has been developed based on massive industrial experience of ferritic/martensitic steel replacing Mo and Nb of high chromium heat resistant martensitic steels (such as modified 9Cr-1Mo) with W and Ta, respectively. As one of RAFMs, F82H, which has been developed and studied in Japan, is designed with emphasis on high temperature property and weldability, and was provided and evaluated in various countries as a part of the collaboration of IEA fusion materials development. Although F82H is the well perceived RAFM as ITER Test Blanket Module (TBM) structural material, the weldability was proved though TIG, EB and YAG laser weld tests using only 15 and 25 mm thickness plate.

In order to reduce the welding distortion, the residual stress and the area of the heat affected zone, it is necessary to decrease the total heat input under the welding. Recently, as a result of R&D efforts about the sources of laser beam, a high-power fiber laser beam has been developed as one of the desirable heat sources for high-speed and deep-penetration welding. Since the power density of the fiber laser beam is very large, it is possible to increase the welding speed more than 10 m/min. So, in this study, the weldability of 1.5 mm thickness F82H plate and pipe was examined by using a ultra power density fiber laser, in order to reveal the excellent weldability of F82H.

As a basic study of the butt welding between 1.5 mm plate and 1.5 mm thickness pipe with 11 mm outer diameter, the focus position, the beam position and the laser power were varied using 25 mm square plate and 25 mm length pipe. Then, by using the fiber laser with 1.1 MW/mm² peak power density under the appropriate welding condition obtained from the basic study, a full penetrated weld bead with narrow width was formed in the butt welding at both edges of 4 mm with strip to 150 mm length pipes.