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## **Anisotropic fracture toughness properties of a Nitronic 50 forging at 4.2 K**

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Fracture toughness of a forging material Nitronic 50 (ASTM A182 F XM-19) was investigated at 4.2 K. The L-T and L-S specimens were used in this study. The expected directions of crack propagation for these specimens are parallel to the width (long transverse) direction and the thickness (short transverse) direction, respectively. In the fatigue pre-cracking for both specimens and J-tests of the L-T specimens, the crack extension followed the expected direction without diverting. In J-tests of the L-S specimens, however, the crack path changed to almost 90° with respect to general crack propagation plane inside the compact tension specimen, meaning that the L-S specimens show a strong anisotropy.

The evaluation of the J-integral test using the ASTM standard E1820 could be therefore not applied, as the unloading slopes of the determined load versus displacement record relies on the standard compliance function of a compact tension specimen where the crack extension is at the 0° plane, not at 90° plane. For this reason, a new consistent compliance function was determined by modeling anisotropic specimens by a FEM approach. In addition, the FEM procedure was verified nearly in a perfect manner by using several compact tension specimens which have similarly-shaped mechanical notches and measuring experimentally their stiffness at room temperature. Using the new compliance function and inserting this fit equation into the evaluation software, the fracture toughness of the anisotropic material could be estimated.

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