Aalto University
School of Engineering

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Fracture of dissimilar metal welds

Title of the dissertation	Fracture toughness, crack path and strength mismatch of Alloy 52 dissimilar metal weld
Contents of the dissertation	Fracture mechanics has evolved during the last 50 years and become a powerful, everyday tool for analysis of structural integrity of safety critical components. Despite the progress, the developed experimental characterization methods for fracture toughness are mainly applicable for macroscopically homogeneous materials. Therefore, the focus of this thesis is on investigating fracture toughness characterization for dissimilar metal welds (DMW), particularly the interface region between hard and soft materials. The objective is to investigate the effect of crack path and strength mismatch on fracture toughness of an Alloy 52 DMW. The results show that the η-parameters developed for homogeneous materials can be used for a crack at an interface between a hard and a soft material, meaning that the current solutions work in this case. Variations in η-parameter occur when distance between the crack and the soft/hard interface increases. Secondly, for cracks that deviate towards the same weak region, the farther the crack is from the weakest region, the larger is the fracture toughness. This applies both in the brittle and ductile region. Noticeably, the cracks continue the growth along the weak region, even if there is a softer zone adjacent to the weak zone. Thirdly, a model for predicting the effect of crack location on fracture toughness was derived and validated. The model is applicable as long as the initiation of brittle fracture occurs in a specific zone, the weak zone. The observations made in this thesis contribute to more cost-efficient fracture toughness characterization of DMWs, and the results show that the current standardized fracture mechanical characterization methods can be applied for DMWs. The results can also be utilized for developing better characterization tools for welds. Future work should focus on investigating various DMWs to understand the fracture behavior under different conditions.
Field of the dissertation	Mechanical engineering, Fracture mechanics
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Väitöskirja on julkisesti nähtävillä Aalto-yliopiston insinööritieteiden korkeakoulun virastomestarin ilmoitustaululla (Otakaari 4).