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Evolution of Nonlinear Acoustics during Creep in Welded Joint for High Cr Ferritic Heat Resisting Steels

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Abstract

We investigated the relationship between microstructural change and the evolutions of two nonlinear acoustic characterizations with electromagnetic acoustic resonance (EMAR) throughout the creep life in the welded joints of ASME Grade 122, one of high Cr ferritic heat resisting steels. One was resonant frequency shift and other three-wave mixing. EMAR was a combination of the resonant acoustic technique with a non-contact electromagnetic acoustic transducer (EMAT). We used bulk- shear-wave EMAT, which transmits and receives shear wave propagating in thickness direction of a plate specimen. Creep tests of thick welded joints specimens were interrupted at several time steps at 873 K, and 100 MPa. Two nonlinear acoustic parameters and ultrasonic attenuation decreased from the start to 50% of creep life. After slightly increased, they rapidly increased from 80% of creep life to rupture. We interpreted these phenomena in terms of dislocation recovery, recrystallization, and restructuring related to the initiation and growth of creep void, with support from the SEM and TEM