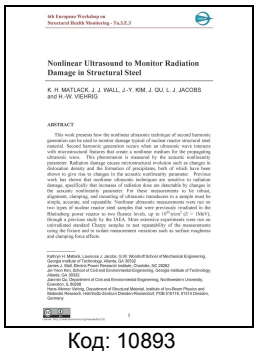

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Nonlinear Ultrasound to Monitor Radiation Damage in Structural Steel

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This work presents how the nonlinear ultrasonic technique of second harmonic generation can be used to monitor damage typical of nuclear reactor structural steel material. Second harmonic generation occurs when an ultrasonic wave interacts with microstructural features that create a nonlinear medium for the propagating ultrasonic wave. This phenomenon is measured by the acoustic nonlinearity parameter. Radiation damage causes microstructural evolution such as changes in dislocation density and the formation of precipitates, both of which have been shown to give rise to changes in the acoustic nonlinearity parameter. Previous work has shown that nonlinear ultrasonic techniques are sensitive to radiation damage, specifically that increases of radiation dose are detectable by changes in the acoustic nonlinearity parameter. For these measurements to be robust, alignment, clamping, and mounting of ultrasonic transducers to a sample must be simple, accurate, and repeatable. Nonlinear ultrasonic measurements were run on two types of nuclear reactor steel samples that were previously irradiated in the Rheinsberg power reactor to two fluence levels, up to 1020n/cm2 (E > lMeV), through a previous study by the IAEA. More extensive experiments were run on unirradiated standard Charpy samples to test repeatability of the measurements using the fixture and to isolate measurement variations such as surface roughness and clamping force effects.

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Ключевые слова:

Содержание