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UT Signals Processing for Characterization of UMo Fuel Plates

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ABSTRACT

Uranium-molybdenum alloys (U-Mo) has shown promising result under irradiation test. Nevertheless, the results of under irradiation qualification of nuclear fuel, based on U-Mo alloys, are still far from the expected. Although many efforts has been made to understand the phenomena governing the UMo behaviour in pile, new evaluation methods and criteria are needed to characterize the fuel/matrix interaction. The behavior of this fuel depends on the physical conditions to which it is subjected and, mainly, of the relation between microstructure and its properties. Non-destructive testing as Ultrasonic Testing (UT) technique may play a key role for characterization and in-pile monitoring of a very anisotropic product, as the fuel plates. The mode of propagation, the attenuation, diffraction, scattering and absorption are parameters of ultrasonic signals which correlates several physical properties, like elastic constants, microstructure, discontinuities and mechanical properties. Thus, ultrasonic parameters could provide important information for characterization, monitoring and prediction of future performance.

This paper provides an evaluation, based on mathematical processing, of attenuation and transmission of UT signals, traveling through of U-Mo fuel miniplates. A set of 8 dispersion type miniplates has been manufactured by CCHEN´s fuel factory, with uranium densities from 1 to 8 gU/cm^3. These miniplates were evaluated by means an ultrasonic scanning test, using Panametrics Pulse-Receiver PR 5800 system and transducers of 20 and 25 MHz. The data set collected for each miniplate were processed using the fft(x) function in MATLAB®, a fast transform algorithm to compute the Fourier transform of the data.

The results of this out-of-pile study shows that the attenuation coefficient of ultrasonic signals increases linearly in function of uranium density. Starting of 12.3 dB/mm for 1 gU/cm^3 up to 74.2 dB/mm for 8 gU/cm^3. In other hand, the transmission percentage of UT signal decreases linearly in function of uranium density, and this percentage varies from 66.7% for 1 gU/cm^3 up to 9.1 % for 8 gU/cm^3. As conclusion, the response of fuel plates exposed to UT signals is strongly affected by uranium density. Besides, processing of UT signal allows to evidence densities changes, correlated with physical, mechanical and microstructural transformations.