ADVANCED NON-DESTRUCTIVE ASSESSMENT TECHNOLOGY TO DETERMINE THE AGING OF SILICON CONTAINING MATERIALS FOR GENERATION IV NUCLEAR REACTORS

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ABSTRACT. To create an in-situ, real-time method of monitoring neutron damage within a nuclear reactor core, irradiated silicon carbide samples are examined to correlate measurable variations in the material properties with neutron fluence levels experienced by the silicon carbide (SiC) during the irradiation process. The reaction by which phosphorus doping via thermal neutrons occurs in the silicon carbide samples is known to increase electron carrier density. A number of techniques are used to probe the properties of the SiC, including ultrasonic and Hall coefficient measurements, as well as high frequency impedance analysis. Gamma spectroscopy is also used to examine residual radioactivity resulting from irradiation activation of elements in the samples. Hall coefficient measurements produce the expected trend of increasing carrier concentration with higher fluence levels, while high frequency impedance analysis shows an increase in sample impedance with increasing fluence.

Keywords: Transmutation, Silicon Carbide, Nuclear Reactor Sensor, Nondestructive
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INTRODUCTION

The materials in the core of a nuclear reactor experience radiation transmutation and material structural aging. Sensor materials need to be identified and calibrated for damage and be used as references to correlate to irradiation damage occurring in other reactor core components. Silicon carbide (SiC) was selected as such a material to correlate property changes as it is irradiated. Silicon carbide was chosen as the material of interest for its ability to withstand significant radiation damage at high fluences [1]. The radiation damage effect can be assessed by nuclear transmutation and structural damage to the SiC

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