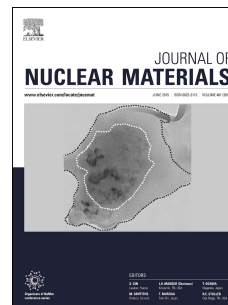


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Implementation of a multilayer model for measurement of thermal conductivity in ion beam irradiated samples using a modulated thermoreflectance approach

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1 Implementation of a multilayer model for measurement of thermal conductivity in  
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6

7 Laser based modulated thermoreflectance (MTR) technique is an attractive method for  
8 measuring thermal conductivity in ion irradiated samples. Unlike laser flash analysis,  
9 traditionally used for measuring thermal conductivity in nuclear materials, the MTR method is  
10 sensitive to damage that is only a few micrometers thick. This allows MTR to detect damage  
11 resulting from a few MeV ion beam irradiation. MTR combined with tailored ion beam  
12 irradiations offers a promising opportunity for validation of lower-scale thermal conductivity  
13 models developed for irradiated materials. In this technique, a harmonically modulated laser  
14 pump heats the irradiated sample and a probe beam measures the temperature induced changes in  
15 the sample's reflectivity. Interpretation of the measured temperature profiles in ion irradiated  
16 samples is complicated by the nonhomogeneous damage profile and the presence of an  
17 additional thin metal transducer layer. In this work, we present a detailed analysis of the  
18 experimentally measured thermal wave profiles in  $\text{UO}_2$  samples irradiated with 2.6 MeV  $\text{H}^+$  ions  
19 using different multilayer approximations of the damaged region. The limitation of an infinite  
20 damage layer approximation that assumes uniform damage across the thickness of the sample  
21 and neglects the undamaged region is discussed. Presented analysis outlines the method for  
22 determination of the applicability range for the infinite damage model. Finally, an analysis of the

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