Contribution ID: **10** Type: **not specified**

Neutron imaging and the destroyed nuclear fuels from Fukushima-1 nuclear power plant accidents

Monday, 16 April 2012 15:15 (3 minutes)

The non-destructive techniques, as mentioned in the followings, are to be applied usefully for non-destructive analysis of failed core fuels and materials in the reactors no.1-3 and spent fuels in the fuel pools no.1-4 in the Fukushima-Daiichi PPTs.
Heavy elements like as actinides have commonly a sharp neutron resonance absorption. Resonance energy depends intrinsically on nuclide structure. So different resonance energy is observed among its isotopes. Using neutron radiographic imaging, 3-dimmensional distribution of isotopes in the material may be visualized individually. This can be applied to the post-irradiation examination of nuclear fuel elements containing various actinides and their isotopes. This work is concerned to neutron radiographic post-irradiation examinations of nuclear fuel materials by using a newly proposed, designed and fabricated "gamma-ray insensitive"Imaging Plate. Some experimental results are characterisation of the newly fabricated imaging plate (Dy-IP) and its application for experimental neutron radiography test under realistic post-irradiated conditions. The gamma-ray fogging is suppressed by the direct imaging technique using a Dy-containing imaging plate. Imaging procedures of Dy-IP is modelled as (1)neutron(and gamma-ray) exposure, (2)erasure by visible light, (3)self-exposure by radio-activated Dy, and (4)readout of photo-stimulated luminescence (PSL).
The realistic post-irradiated NR experiment using the Dy-IP has been conducted in a usual manner at the NEURAP installation of SINQ, PSI. This setup enables the inspection of rod-type samples within a well -shielded facility, where the positioning in height and angular position can be handled precisely. Just after neutron exposure (for 24 min) and erasing the direct exposure image (for about 15 min), the PSL material of the IP is exposed auto-radiographically for 120 min by the Dy-165 decay in the Dy-IP sheet, which results in -fog free NR imaging. The direct technique image by Dy-IP is very clear and high contrast. Spatial resolution is 0.200mm.
Gamma-fog free NR images have been obtained for the post irradiation nuclear fuel pin. Hydrogen precipitates in the cladding and inter-fuel pellet gap are clearly observed. The method is very useful for the inspection and even quantitative analysis of highly activated probes as spent fuel, reactor core components and spallation target rods. Details are found in the references.

References

1)M.TAMAKI et al., "Record and display methods of neutron radiographic imaging", Japan patent Heisei_11-23799(1999).
2)M. TAMAKI et al., "The direct dysprosium(Dy) imaging technique and its experimental test under realistic conditions during the NEURAP-18 run", PSI Scientific Report 2003,3,187 (2004).
3)M.TAMAKI et al., "Dy-IP Characterization and its Application for Experimental Neutron Radiography Tests under Realistic Conditions", Nucl.Instrum. Meth. A, 542,320-323(2005).
4)M.TAMAKI et al., "Post-irradiation Analysis of SINQ Target Rods by Thermal Neutron Radiography", J.Nucl.Mater., 356, 162-167(2006).
5) M.TAMAKI et al., "Post-Irradiation Examination using Neutron Imaging Technique for Visualization of Hydride Precipitates in Nuclear Fuel Cladding"Proc. of Symposium on Water Chemistry and Corrosion in Nuclear Power Plants in Asia 2009, October , 2009, Nagoya, Japan.

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Session Classification: Short presentations (Poster session)