Experimental report

26/01/2021

Proposal: CRG-2771 **Council:** 4/2020

Title: Measurements of the neutron elasticscattering angular distribution ofThO2 below 300K

Research area:

This proposal is a new proposal

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Samples: ThO2

Instrument	Requested days	Allocated days	From	To
D1B	3	2	23/09/2020	25/09/2020

Abstract:

Measurements of the neutron elastic scattering angular distribution of ThO_2 below 300 K

The present document provides a short description of the experiment performed on a ThO2 sample at the D1B instrument of ILL in September 2020. The neutron elastic scattering angular distribution of ThO2 was studied from 2 K to 300 K for an incident neutron energy of 49.93 meV.

Sample characteristics

The ThO2 sample used for this experiment was composed of a stack of 12 ThO2 pellets in a double sealed ZrY4 container (Fig. 1). The mass of the ThO2 sample was 45.232 g (ρ=9.3 g/cm^3) with a height and diameter (without ZrY4 container) equal to 9.312 cm and 8.1558 mm, respectively. The thicknesses of the inner and outer ZrY4 containers were equal to 1.25 mm and 0.42 mm, respectively. A ZrY4 rod (Diameter of 1 cm) was used for the container subtraction.

Fig. 1. ThO2 sample in the ZrY4 container with its Al sample holder wrapped in a Cd foil.

Experimental program

The experiments were performed on the D1B (λ=1.28 Å, E=49.93 meV) spectrometer. A description of the experimental program is listed in Table 1. It consisted in measuring sequentially ThO2-ZrY4 and ZrY4-rod. Raw data provided by the acquisition system were treated with the LAMP package developed at ILL.

Preliminary results

A precise experimental validation of the neutron elastic scattering angular distribution of ThO2 is not possible because the neutron cross sections of this material is not available in the international neutron libraries dedicated for reactor applications. The analysis and interpretation of the data measured with the D1B spectrometer will first consist in testing the processing code CINEL, which is devoted to create nuclear data libraries for the Monte-Carlo code TRIPOLI4. Figure 2 shows the diffraction patterns obtained for the ThO2+ZrY4 and ZrY4-rod samples. This result will allow testing the performances of our Monte-Carlo simulation tool below room temperature.

Table 1. Details of the experimental program (IN6 spectrometer)

ThO2 + gaine Zircaloy	cooling from 2K	#478466-478468 20minx3
ThO2 + gaine Zircaloy	cooling from 20K	#478469-478471 20minx3
ThO2 + gaine Zircaloy	cooling from 40K	#478472-478474 20minx3
ThO2 + gaine Zircaloy	cooling from 60K	#478475-478477 20minx3
ThO2 + gaine Zircaloy	cooling from 80K	#478478-478480 20minx3
ThO2 + gaine Zircaloy	cooling from 100K	#478481-478483 20minx3
ThO2 + gaine Zircaloy	cooling from 120K	#478484-478486 20minx3
ThO2 + gaine Zircaloy	cooling from 140K	#478487-478489 20minx3
ThO2 + gaine Zircaloy	cooling from 160K	#478490-478492 20minx3
ThO2 + gaine Zircaloy	cooling from 180K	#478493-478495 20minx3
ThO2 + gaine Zircaloy	cooling from 200K	#478496-478498 20minx3
ThO2 + gaine Zircaloy	cooling from 220K	#478499-478501 20minx3
ThO2 + gaine Zircaloy	cooling from 240K	#478502-478504 20minx3
ThO2 + gaine Zircaloy	cooling from 260K	#478505-478507 20minx3
ThO2 + gaine Zircaloy	cooling from 280K	#478508-478510 20minx3
ThO2 + gaine Zircaloy	cooling from 300K	#478511-478513 20minx3
CO 128A	RT 13/13 4/4	#478514-478515 10minx2
Si 128A	RT 5/5 2/2	#478517-478518 10minx2
NAC 128A	RT 5/5 2/2	#478519-478520 10minx2
Zircaloy 1.28A	2K	#478532-478534 20minx3
Zircaloy 1.28A	40K	#478535-478537 20minx3
Zircaloy 1.28A	80K	#478538-478540 20minx3
Zircaloy 1.28A	120K	#478541-478543 20minx3
Zircaloy 1.28A	160K	#478544-478546 20minx3
Zircaloy 1.28A	200K	#478547-478549 20minx3
Zircaloy 1.28A	240K	#478550-478552 20minx3
Zircaloy 1.28A	280K	#478553-478555 20minx3
Zircaloy 1.28A	300K	#478556-478558 20minx3

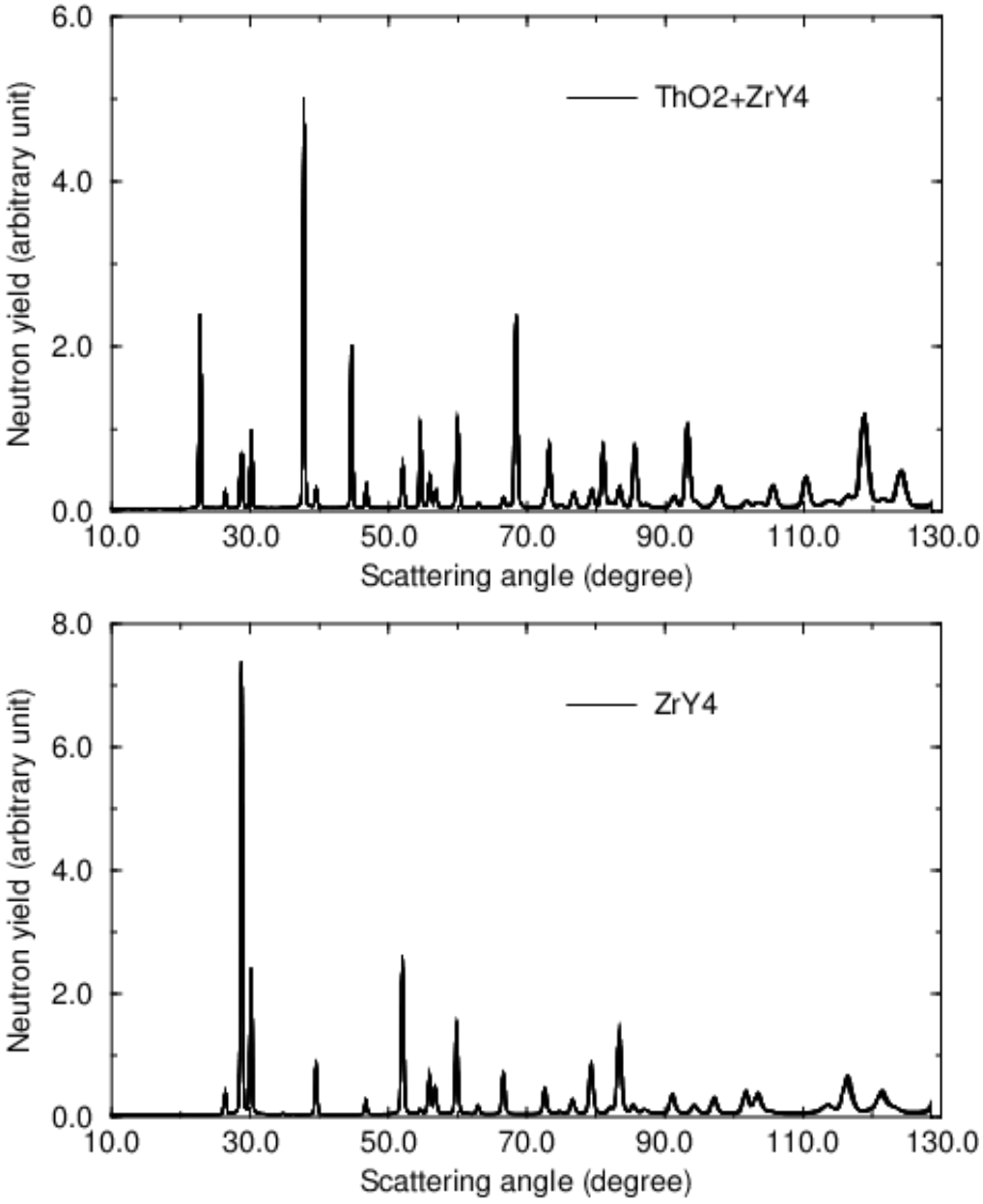

Fig. 2. Diffraction patterns obtained with the ThO2+ZrY4 and ZrY4-rod samples below 300 K.