Ultra-Small-Angle Neutron Scattering at JRR3
*SANS-J-II & PNO Spectrometers*

S. Koizumi Ibaraki Univ. (2011/10 ~ )

Y. Noda, Z. Yue, R. Kikuchi and D. Yamaguchi
Japan Atomic Energy Agency

Current Status of Ultra-Small-Angle Neutron Scattering at JRR-3, Tokai, Japan

Complimentary Use of
Double Crystal Type (PNO) & Pinhole Type (SANS-J-II)

Before 2005

![Diagram showing q range for PNO and SANS-J-II before 2005](image)
Current Status of Ultra-Small-Angle Neutron Scattering at JRR-3, Tokai, Japan

Complimentary Use of Pinhole Type (SANS-J-II) & Double Crystal Type (PNO)

SANS-J-II since 2005

C-3-2 (Cold Neutron)@JRR3 (10^8 /cm^2/sec)

Monochromator:  ● Velocity Selector (Hungary)

\( \lambda = 6.0 \text{A} \) (4000 rpm), \( \Delta \lambda / \lambda = 8\text{-}13\% 

Collimation:  \( S_1 = 20 \) & \( S_2 = 8 \text{ mm} \phi \) (10^6 /cm^2/sec @sample)

Detector:  ● ^3\text{He} Position Sensitive Detector (RISO, Denmark)

60cm Diameter & 5 mm resolution

Beam Stopper 40mm\phi

Camera Length:  ● 1.3m ~10m

Available q is \( 0.003 > q > 0.2 \ (0.4) \text{A}^{-1} \)
C-3-2 (Cold Neutron) @ JRR3 \((10^8 / \text{cm}^2/\text{sec})\)

**SANS-J-II since 2005**

ICNS 2005@ Sydney
Construction collaboration (J. Suzuki, H. Iwase & T. Oku)

**Neutron lens**
Biconcave & Spherical (MgF\(_2\))
designed by RISO
Radius of Curvature 25mm

30mm

70 pieces for 6.5 A
L\(_S\)=9.6m

**Beam Stopper**

**3He Detector**

40mm

**Flagging**

USANS (~ 10\(^{-4}\) A\(^{-1}\))

**High resolution 2D detector**

3He Detector
60 cm Size
5mm Resolution

Cross-Wired Position Sensitive Photomultiplier R3239

ZnS/\(^6\)LiF Scintillator (0.2mm thickness)

5 inch Size, 0.5 mm Resolution

**Simultaneous Measurement Mode**

Construction collaboration (J. Suzuki, H. Iwase & T. Oku)

**ICNS 2005@ Sydney**

2010, May
Current Status of Ultra-Small-Angle Neutron Scattering at JRR-3, Tokai, Japan

Complimentary Use of Pinhole Type (SANS-J-II) & Double Crystal Type (PNO)
Perfect silicon is transparent for neuron!

**Measurement Time ~20 hours!**

![Diagram showing tandem analyser Bonse-Hart USANS spectrometer with 2nd goniometer, rotation, detector shield, Si (111) sample, beam stop, and 3He detector.]

- **Sintered B₄C**
- **Incident neutron**
- **2nd goniometer**
- **Rotation**
- **Detector shield**
- **Si (111) Sample**
- **Beam stop**
- **3He Detector**

**Perfect silicon is transparent for neuron!**

![Diagram showing tandem optical setup with monochromator, sample, Si grooved perfect crystal, Off-Bragg, On-Bragg, Silicon grooved, Perfect Crystal, counter 1, counter 2, and 3rd goniometer.]

**Measurement Efficiency: Double!**

- **Standard measurement time**
  - **5~6 hours**

**ICNS2005 Sydney**

D. Yamaguchi and S. Koizumi

*Phys. B, 385-386, 1190 (2006).*
Two Spectrometers Shear Same Sample Environments!

**Common Sample Holders**

- 15x40 mm² (PNO)
  - λ=2Å
- 20° (SANS-J-II)
  - λ=6Å

Sample thickness: 0.5 ~ 10 mm

**Common Auto Sample-changers**

User Request
Better to be in a same beam hole!

**On Bonse-Hart USANS (PNO)**

Standard measurement time
5~6 hours
3~4 hours for focusing USANS
0.1~2 hours for pinhole SANS

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Hierarchical Structure in Biology

II. USANS on Living Cells (Invivo)

*Acetobactor Xylinium*

*Synthesizing extra cellular Cellulose*

Collaboration with
T. Kondo, Y. Tomita.
Agriculture Center, Kyusyu Univ.

H. Iwase (Cross)
Acetobacter Xylinum, producing Cellulose

Growth Rate: $2.6\mu m/min$ (at 28C)

$5000$ glucose/min ($100$ glucose/sec)

Sub-Elementary Fibril

Microfibril

Ribbon

5$\mu m$

Sub-Elementary Fibril

Polymerization-induced Self-assembly

USANS Study on Hierarchical Structure of Microbial Cellulose:


cited from Chapter 5,
“Biosynthesis and Biodegradation of Cellulose”