



Individual Monitoring with the RPL Dosimetry System and New Procedures for COVID-19 Protection

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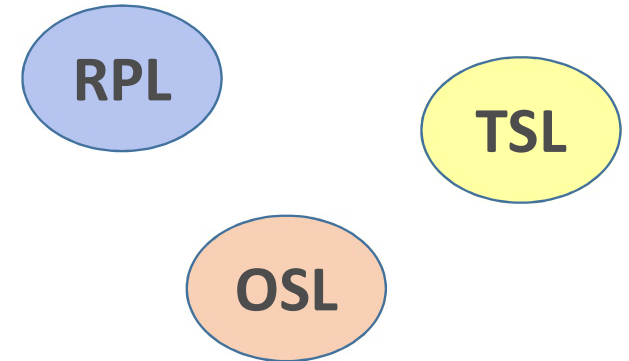
Individual Monitoring with the RPL Dosimetry System

What is RPL ?



Radio-photoluminescence (RPL)

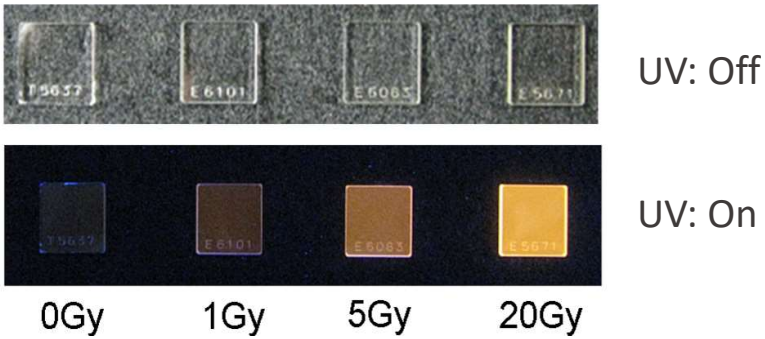
is a luminescence phenomenon.



History:

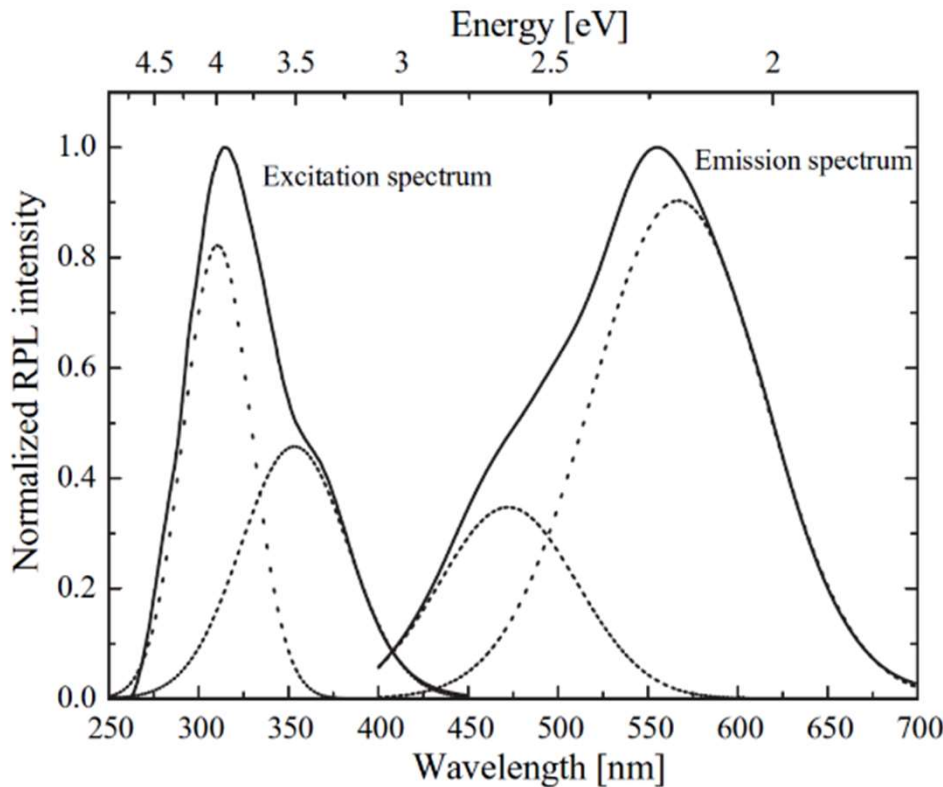
1921: Przibram	First report of the RPL phenomenon
1949: Weyl <i>et al</i> ,	Discovered an RPL phenomenon in an Ag-activated glass
1951: Schulman <i>et al</i> ,	Creation of a new luminescence center
1961: Yokota <i>et al</i> ,	Developed a new RPL material
2000: Chiyoda Technol	Started IMS by using RPL glass

RPL phenomenon



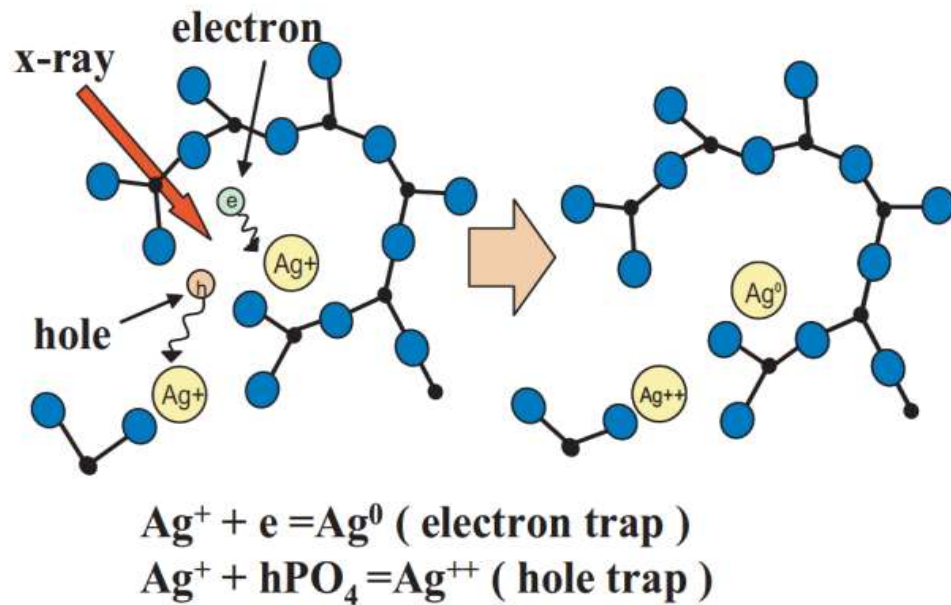
The X-ray induced Ag^{++} color center emits 630 nm luminescence (orange) by UV irradiation.

(Miyamoto *et al.*, 2011)



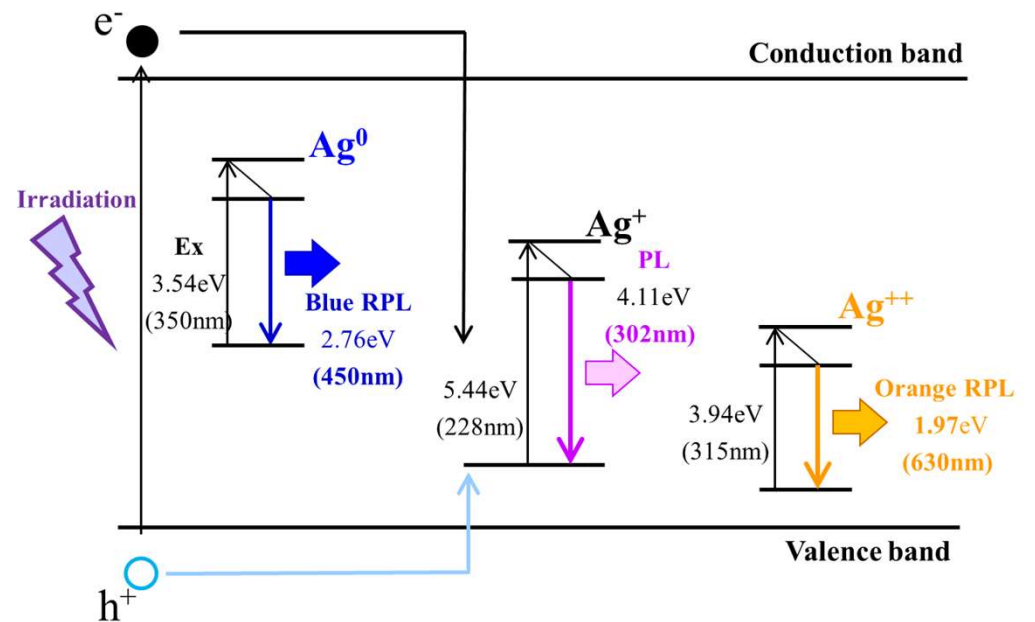
(Miyamoto *et al.*, 2008)

Luminescence model of the RPL



(Miyamoto *et al.*, 2010)

RPL emission model of Ag⁺-activated phosphate glass



(Miyamoto *et al.*, 2011)

RPL dosimeter (Glass Badge)

- Radio-photoluminescence (RPL) glass detector
- CR-39 Solid State Track Detector (SSTD)
- Conformity with relative international standards:
 - IEC 62387 (photon & beta radiation) *2G, 3G
 - ISO 21909-1 (neutron) *3G



1st Generation (2000~)



2nd Generation (2007~)



3rd Generation (2013 ~)

RPL dosimetry in the world



CNRS

Centre National de la
Recherche Scientifique



IRSN

Institut de Radioprotection
et de Surete Nucleaire



PSI

Paul Scherrer Institut



APM Nuclear Technology SDN



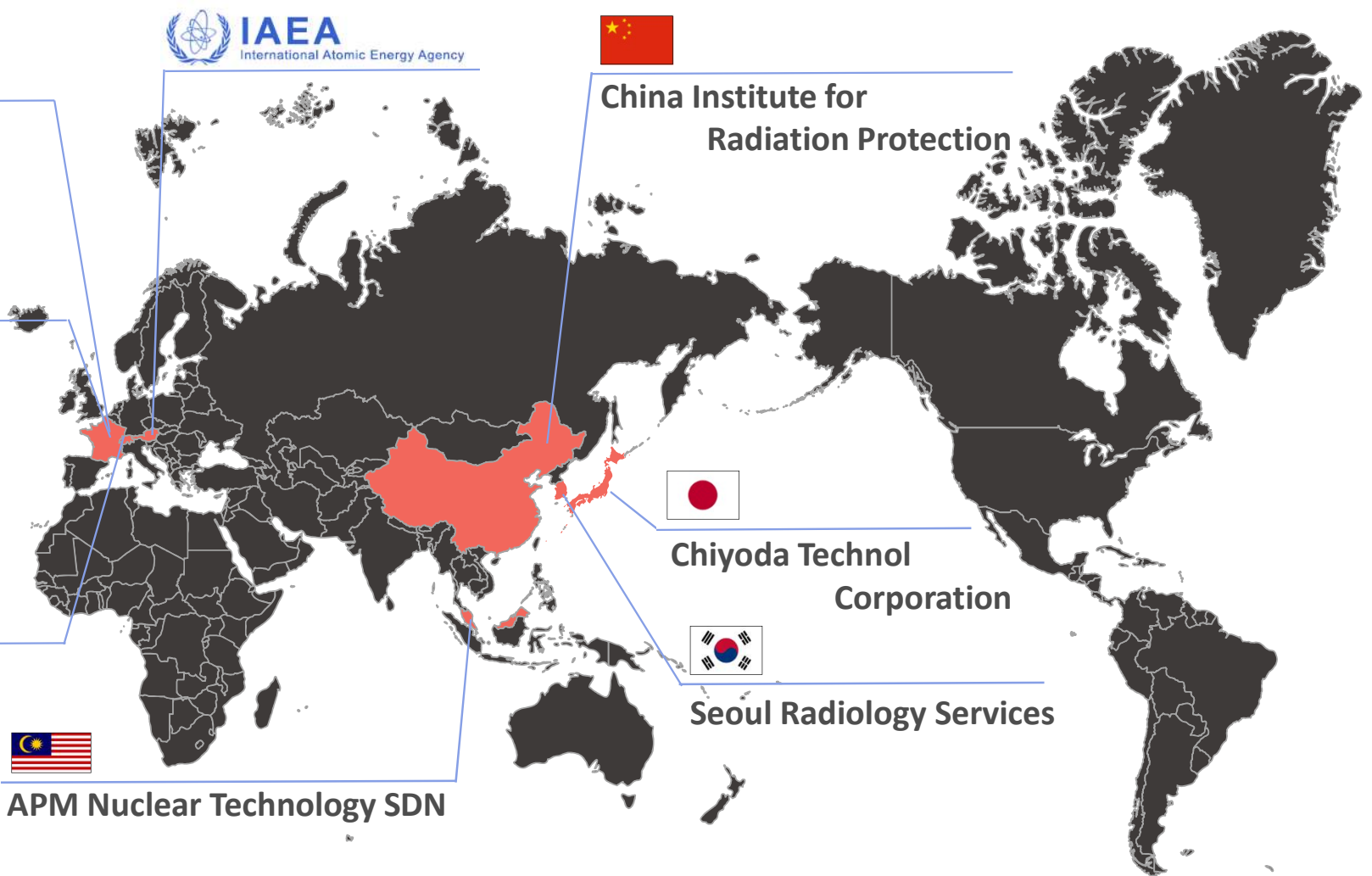
**China Institute for
Radiation Protection**



**Chiyoda Technol
Corporation**



Seoul Radiology Services



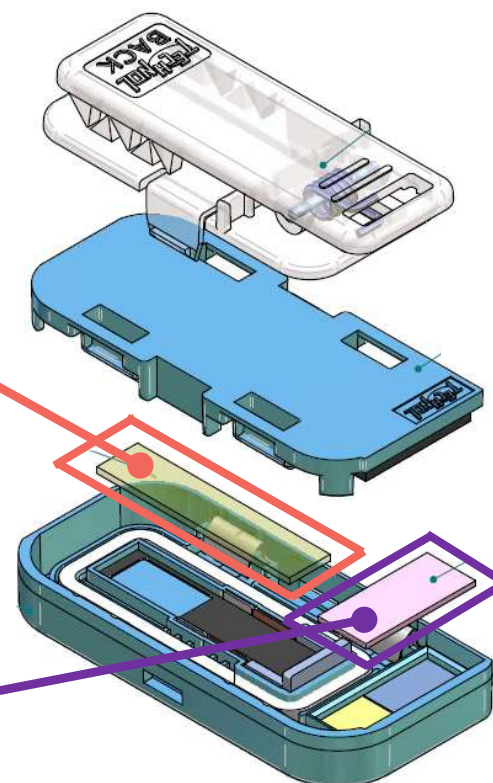
RPL dosimeter (Glass Badge)

RPL glass detector

- Ag+ activated phosphate glass
- Sensitive to photons and beta radiation
- Insensitive to neutrons

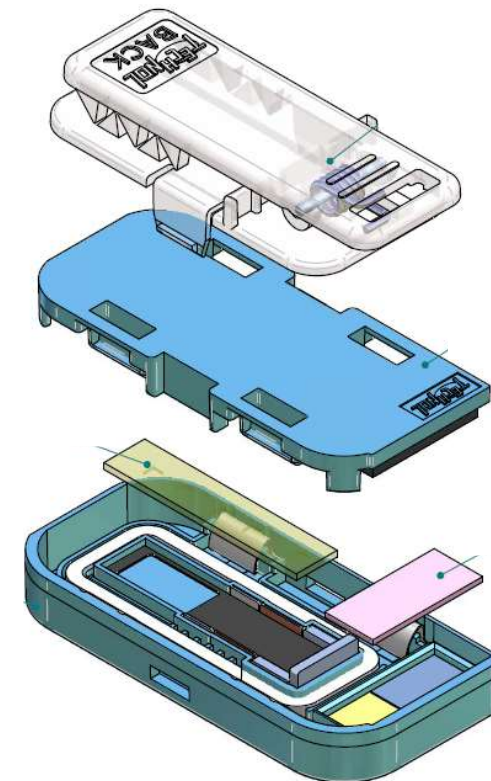
Solid State Track Detector

- Allyl diglycol carbonate plastic (CR-39)
- Sensitive to neutrons via conversion filters
- Insensitive to photons and beta radiation



Specifications of the RPL dosimeter

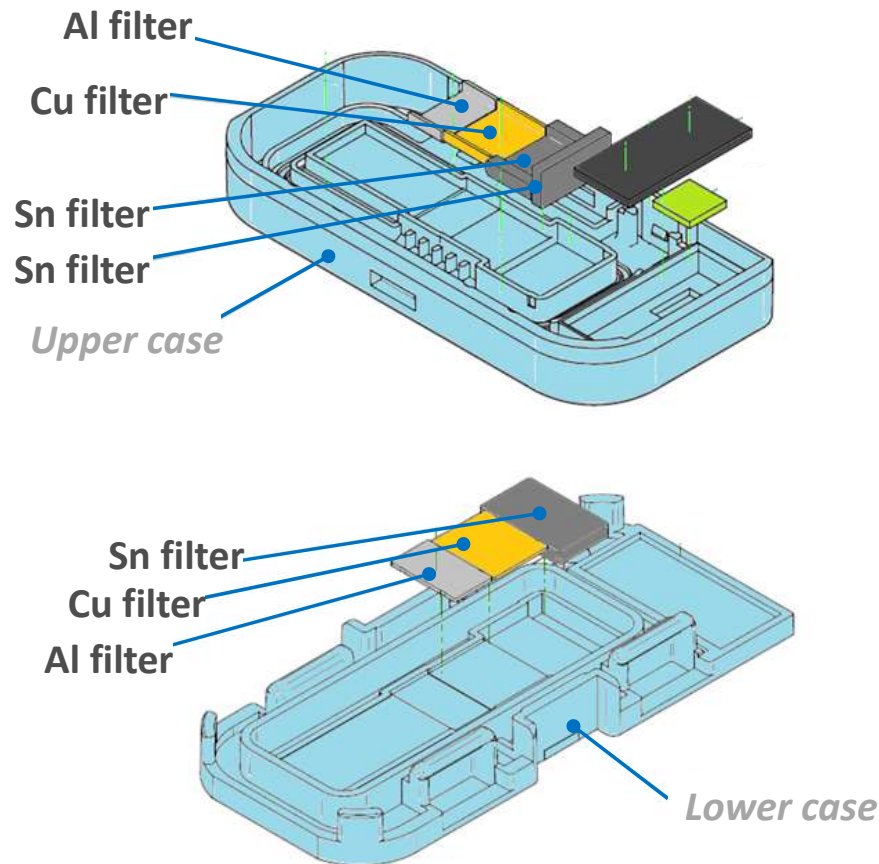
Measurement quantities		$H_p(10)$, $H_p(0.07)$ $H^*(10)$
Measurement energy range	photon beta neutron	16 (12) keV~6.4 MeV 0.2 MeV (^{85}Kr) ~0.8 MeV ($^{90}\text{Sr}/^{90}\text{Y}$) 0.025 eV~15 MeV
Measurement dose range	photon beta neutron (th) neutron (f)	0.1 (0.05) mSv~10 Sv 0.1 mSv~10 Sv 0.1 mSv~8 mSv 0.1 mSv~60 mSv
Compatible standard		IEC 62387 (photon, beta) ISO 21909-1 (neutron)



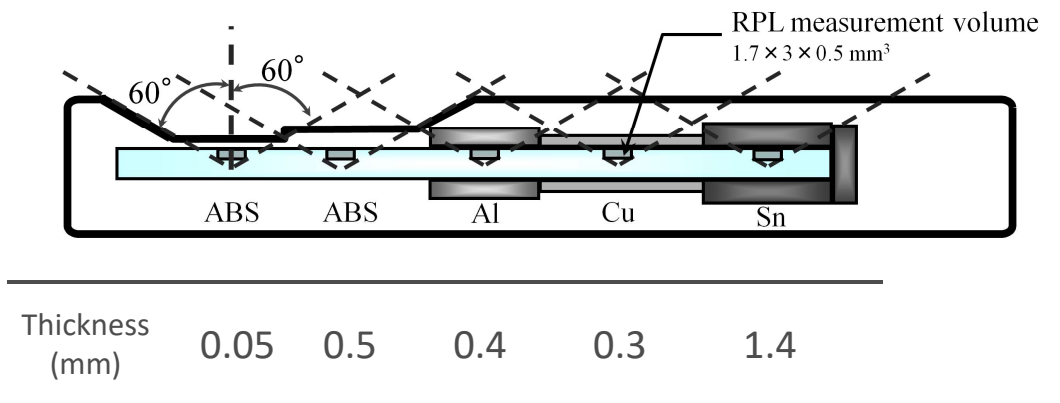
How to measure the dose equivalent

Ag⁺ activated phosphate glass (RPL glass):

$$Z_{\text{eff}} = 12.4$$

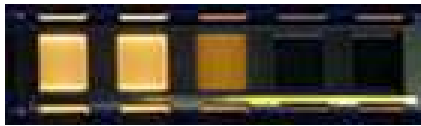


Schematic diagram of the cross section of the dosimeter



(Maki *et al.*, 2015)

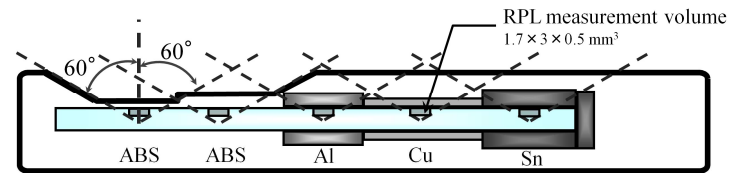
Calculations of the dose equivalent



20 keV X-ray



⁶⁰Co γ-ray

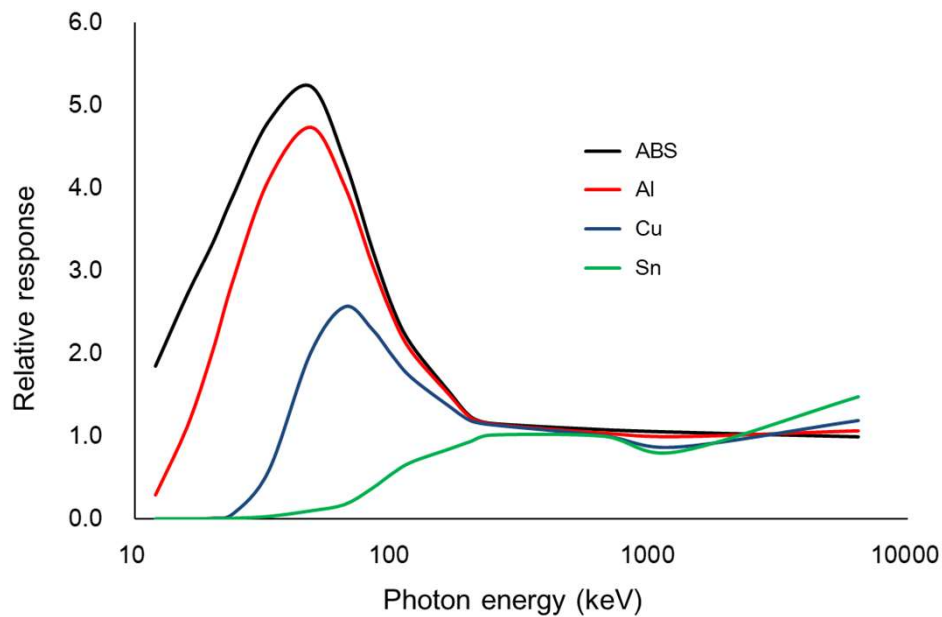


Calculation formula of the dose equivalent:

$$H_p(d) = \sum_i (NAD_i \cdot Ri)$$

NAD_i : Luminescence intensity of the glass detector under the filter i (mGy)

Ri : Constant for each filter i (mSv/mGy)



Features of RPL dosimetry



The RPL glass has good characteristics such as:

- Stability of the sensitivity
- Repeatable readout
- Negligible fading effect
- Excellent reproducibility
- Can be imaged



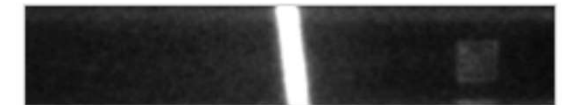
28 keV x-ray in static position



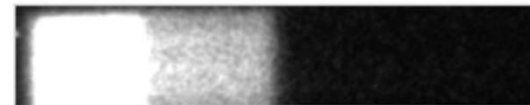
Contaminated dosimeter



28 keV x-ray in dynamic use



Dosimeter left on the scanner table



Beta radiation (Kr-85)



Dosimeter placed behind a metal clip

<http://dosimetrie.irsn.fr/en-us/Documents/Product%20files/RPL%20EN%20WEB.pdf>

Procedure of RPL dosimetry



Wearing the dosemeter

Returned from customer

Disassemble dosemeter package (RPL, CR-39)

RPL (photon, beta)

CR-39 (neutron)

Pre-heating

Etching

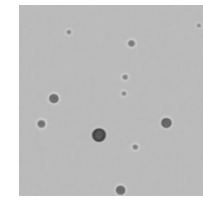
Measurement

Measurement

Dose calculation

Dose calculation

Annealing to initialize



Pre-dose measurement

Dose report

Assemble dosemeter package (RPL, CR-39)

Sent to customer

Other applications

The RPL dosimetry system is used in other applications:

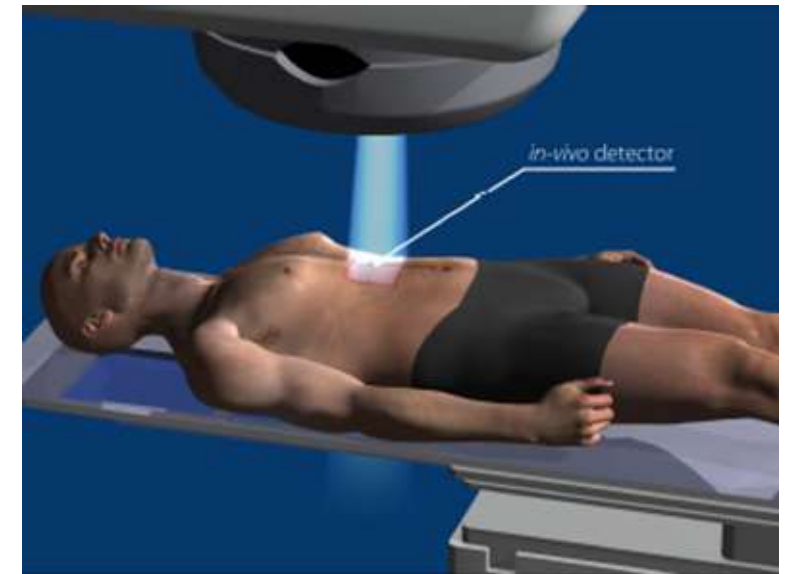
- In-vivo dosimetry for medical
- Postal dose audit service
- Space radiation measurement



Reader



Controller PC





New Procedures for COVID-19 Protection

Our Dosimetry Service



- Dosimetry services for:

- ✓ Medical
- ✓ Veterinary
- ✓ Industrial
- ✓ Research & Education
- ✓ Nuclear (power plant, fuel production)
- ✓ Decontamination
- ✓ Public

- Number of services (dosemeters)

- ✓ Whole body doseimeters (p/β): 390 000 /month
(n) : 45 000 /month
- ✓ Extremity doseimeters : 10 000 /month
- ✓ Eye lens doseimeters : 200 /month



Radiation Monitoring Center @ Oarai, Japan

Staff members: ≈ 100



Our measures

Before pandemic

- Facility cleaning (every working day)
- No shoes in facility
- Flu vaccination

In preparation of the pandemic

- More frequent facility cleaning
- Sterilization of doorknobs, etc.
- Body temperature measurement
- Wearing a mask
- Avoid the “Three Cs”

Important notice for preventing COVID-19 outbreaks.

Avoid the “Three Cs”!

- 1. Closed spaces** with poor ventilation.
- 2. Crowded places** with many people nearby.
- 3. Close-contact settings** such as close-range conversations.



One of the key measures against COVID-19 is to prevent occurrence of clusters. Keep these “Three Cs” from overlapping in daily life.



The risk of occurrence of clusters is particularly high when the “Three Cs” overlap!

In addition to the “Three Cs,” items used by multiple people should be cleaned with disinfectant.

首相官邸  厚生労働省  MHLW COVID-19 Search 

Special measures and considerations



- Sterilization of envelopes and dosemeters
- Delivery of dosemeters
 - ✓ Customers' self lock-down
 - ✓ Temporary suspension of postal services
- Information provided to customers
- Consideration of BCP
 - ✓ If staff member is infected
 - ✓ Change of measurement period



Summary



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