# How to Analyse $Al_2O_3$:C Measurements

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## Contents



# 1 Scope

The package 'Luminescence' offers three distinct functions dealing with the analysis of $Al_2O_3$:C pellet measurements:

1. `analyse_Al2O3C_ITC()`
2. `analyse_Al2O3C_CrossTalk()`
3. `analyse_Al2O3C_Measurement()`

Only the last function is really needed to routinely estimate the (environmental $\gamma$-) dose the pellet had received. However, the first two functions are needed to determine and later correct for equipment related issues. If you have already performed the first two analysis or you do not feel the need for them, you can direclty start with the last section.

The following tutorial assumes that all measurements have been performed on a Freiberg Instruments *lexsyg SMART* luminescence reader (Richter et al., 2015). However, the general procedure should work also for a Risø TL/OSL reader.

Please further note that this vignette covers only the **R** releated part of the data analysis and will not explain the theoretical and physical background. Please see XXXX for details.

# 2 Determine irradiation time correction factors

## 2.1 Data import

To determine the irradiation time correction factor the function `analyse_Al2O3C_ITC()` is used. The measurement sequence is based on the suggestions made by XXXXX. To import the measurement data run the function 'read_XSYG2R()' and select the measured curves, in our example 'UVVIS'.

```
library(Luminescence)
data_ITC <- read_XSYG2R("MyIrradiationTimeCorrectionMeasurement.XSYG", fastForward = TRUE) %>%
  get_RLum(recordType = "OSL (UVVIS)", drop = FALSE)
data_ITC
```

```
##
## [RLum.Analysis]
##  originator: read_XSYG2R()
##  protocol:
##  additional info elements:  0
##  number of records: 50
##  .. : RLum.Data.Curve : 50
##  .. .. : #1 OSL (UVVIS) | #2 OSL (UVVIS) | #3 OSL (UVVIS) | #4 OSL (UVVIS)
##  .. .. : #5 OSL (UVVIS) | #6 OSL (UVVIS) | #7 OSL (UVVIS) | #8 OSL (UVVIS)
##  .. .. : #9 OSL (UVVIS) | #10 OSL (UVVIS) | #11 OSL (UVVIS) | #12 OSL (UVVIS)
##  .. .. : #13 OSL (UVVIS) | #14 OSL (UVVIS) | #15 OSL (UVVIS) | #16 OSL (UVVIS)
##  .. .. : #17 OSL (UVVIS) | #18 OSL (UVVIS) | #19 OSL (UVVIS) | #20 OSL (UVVIS)
##  .. .. : #21 OSL (UVVIS) | #22 OSL (UVVIS) | #23 OSL (UVVIS) | #24 OSL (UVVIS)
##  .. .. : #25 OSL (UVVIS) | #26 OSL (UVVIS) | #27 OSL (UVVIS) | #28 OSL (UVVIS)
##  .. .. : #29 OSL (UVVIS) | #30 OSL (UVVIS) | #31 OSL (UVVIS) | #32 OSL (UVVIS)
##  .. .. : #33 OSL (UVVIS) | #34 OSL (UVVIS) | #35 OSL (UVVIS) | #36 OSL (UVVIS)
##  .. .. : #37 OSL (UVVIS) | #38 OSL (UVVIS) | #39 OSL (UVVIS) | #40 OSL (UVVIS)
##  .. .. : #41 OSL (UVVIS) | #42 OSL (UVVIS) | #43 OSL (UVVIS) | #44 OSL (UVVIS)
##  .. .. : #45 OSL (UVVIS) | #46 OSL (UVVIS) | #47 OSL (UVVIS) | #48 OSL (UVVIS)
##  .. .. : #49 OSL (UVVIS) | #50 OSL (UVVIS)
```

## 2.2 Run analysis

The imported data are either a single `RLum.Analysis` object or a `list` of such objects, which can be directly passed to the function `analyse_Al2O3C_ITC()`.

*Please note that if you follow the suggestions by XXXX no further arguments are necessary.*

```
results_ITC <- analyse_Al2O3C_ITC(object = data_ITC)
```

```
##
## [analyse_Al2O3C_ITC()]
##
##  Used fit:       EXP
##  Time correction value:  2.59 ± 0.05
```

The analysis returns a plot (Fig.1) and the output is stored in the object `results_ITC` and can be used later.

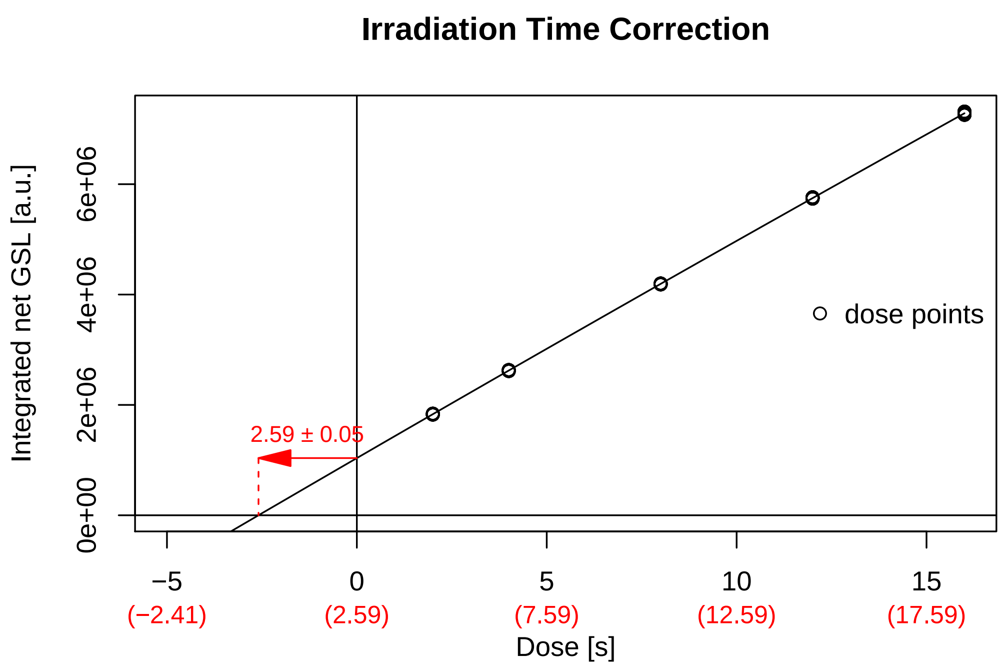


Figure 1: Dose response curve used to correct the irradiation time for the movement duration of the sample carrier.

# 3 Estimate irradiation crosstalk

## 3.1 Data import

The data import is similar to the data import stated above.

```
library(Luminescence)
data_CT <- read_XSYG2R("MyCrossTalkIrradiationMeasurement.XSYG", fastForward = TRUE) %>%
  get_RLum(recordType = "OSL (UVVIS)", drop = FALSE)
data_CT
```

```
##
##  [RLum.Analysis]
##   originator: read_XSYG2R()
##   protocol:
##   additional info elements:  0
##   number of records: 3
##   .. : RLum.Data.Curve : 3
##   .. .. : #1 OSL (UVVIS) | #2 OSL (UVVIS) | #3 OSL (UVVIS)
```

## 3.2 Data analysis

For the data analysis the function `analyse_Al2O3C_CrossTalk()` is called. Amongst others the function holds one parameter `irradiation_time_correction`. This parameter can be left empty or the results from the previous irradiation time correction measurements can be direclty passed to the function. Graphical results are shown in Fig. 2. The numerical output is again an `RLum.Results` object which can be kept for a later usage.

```
results_CT <- analyse_Al2O3C_CrossTalk(
  object = data_CT,
  irradiation_time_correction = results_ITC)
```

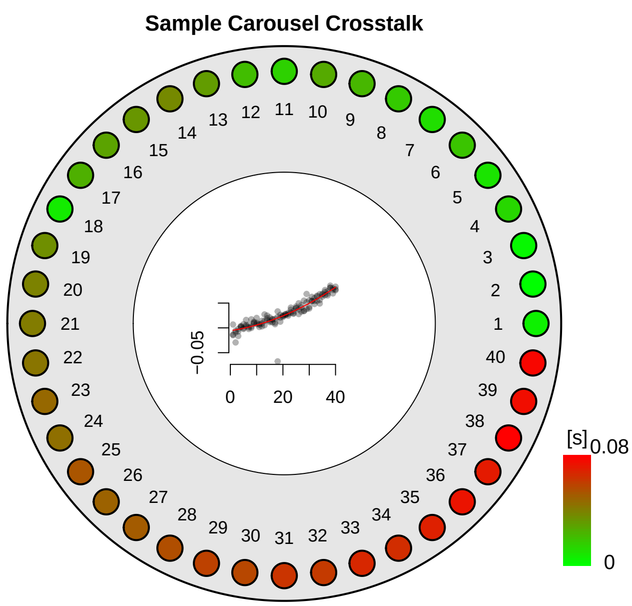


Figure 2: Graphical function output of the crosstalk data analysis.

# 4 $Al_2O_3$:C dose determination

This section describes the workflow for the final apparent dose estimation of the $Al_2O_3$ pellet. The analyses done above are not necessary, but recommended to correct for the equipement characteristics.

# 5 Data import

# 6 Ease your workflow

# 7 References

Richter, D., Richter, A., Dornich, K., 2015. Lexsyg smart — a luminescence detection system for dosimetry, material research and dating application. Geochronometria 42, 202–209. doi:10.1515/geochr-2015-0022