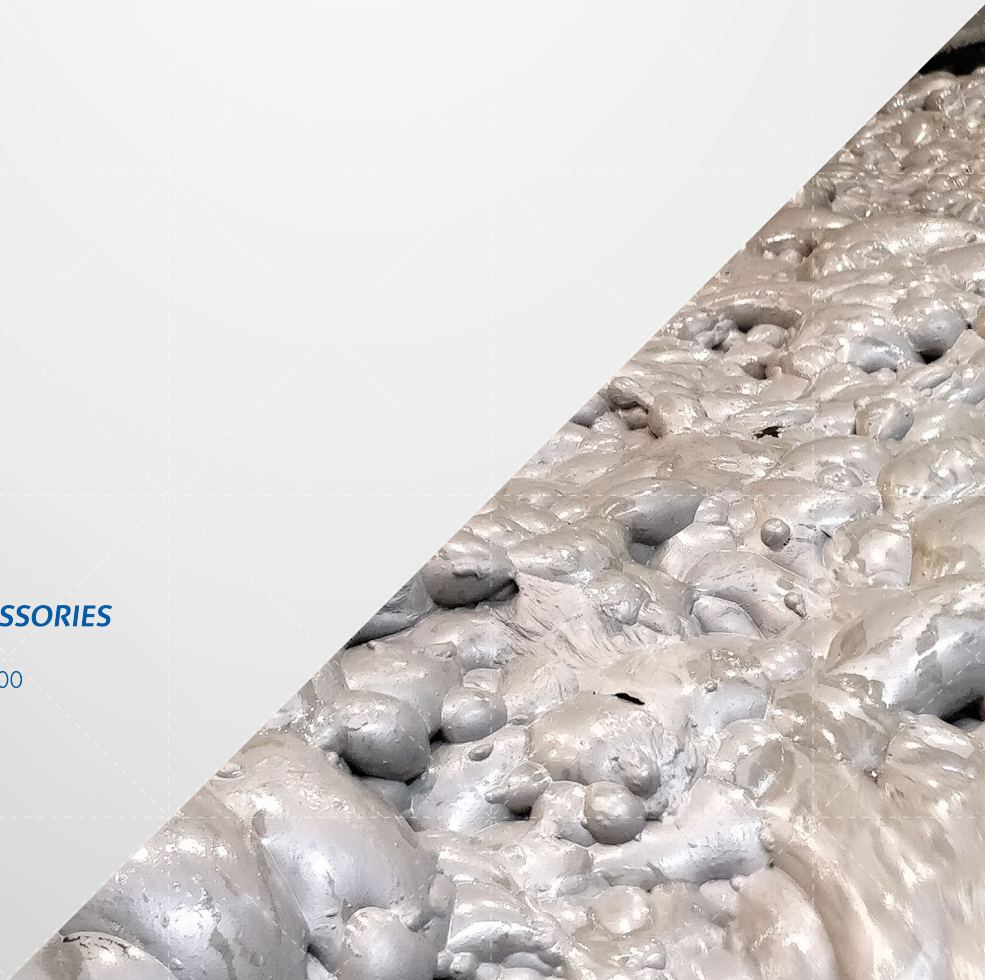
On-line Monitoring for Mineral Processes

Case Studies with
Timegated® Raman Spectroscopy



Distributed by

McCRONE™
MICROSCOPES & ACCESSORIES

www.mccronemicroscopes.com
PH 800-622-8122 or 630-887-7100
mmaorder@mccrone.com

timegate
ahead of time

Timegated® Raman spectroscopy enables continuous, robust, non-destructive and non-contact measurements from solid materials, slurries and liquids and it is used for a growing number of process analytical technology (PAT) applications.

Information is gathered by illuminating the sample with a laser and by collecting the scattered photons. These scattered Raman photons provide composition, mineralogical and polymorphic information. Timegated® Raman enables both quantitative and qualitative measurements. A penlike probe, which is used for both sample illumination and data collection, can be attached to most process stages (see figure 1).

Figure 1.
A measurement probe attached to a flotation cell. A penlike probe can be attached to most process stages. In addition to probes for solid sample measurements, commercial options also include immersion probes for liquid and slurry measurements.

Real-time slurry measurements

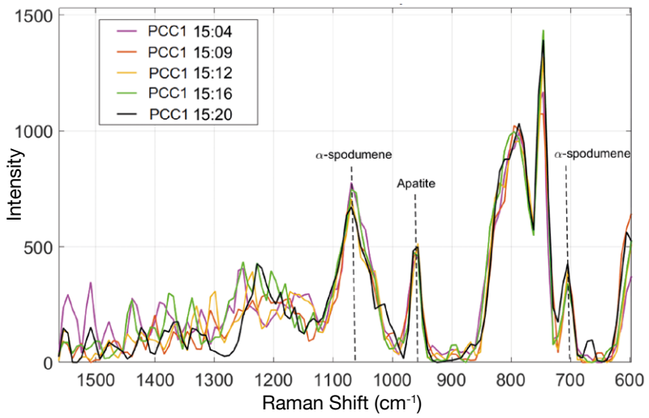


Figure 2.
Automated continuously measured spectra from Keliber Oy Lithium project (Central Ostrobothnia, Finland) ~13m-% slurries. Timestamps are presented in the figure legend. [1] The measured spectra from Keliber Oy slurries provide continuous apatite and α spodumene concentration information. This information can be used for effective real-time process control.

Continuous high temperature measurements

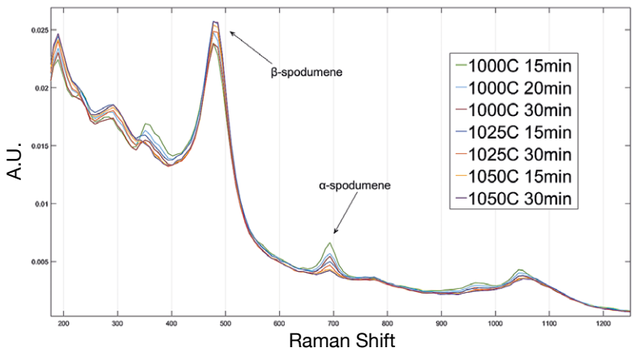


Figure 3.
High temperature measurements from a pure spodumene grain. The measured spectra were used for studying high temperature α to β spodumene conversion. The figure legend presents the instants at which the measurements were carried out after the heating stage reached the related temperature i.e. the first spectrum was measured 15 minutes after the heating stage temperature reached 1000°C. [2] Timegated® Raman enables continuous high temperature measurements and the technology can be used to identify different polymorphs and polymorphic transitions.

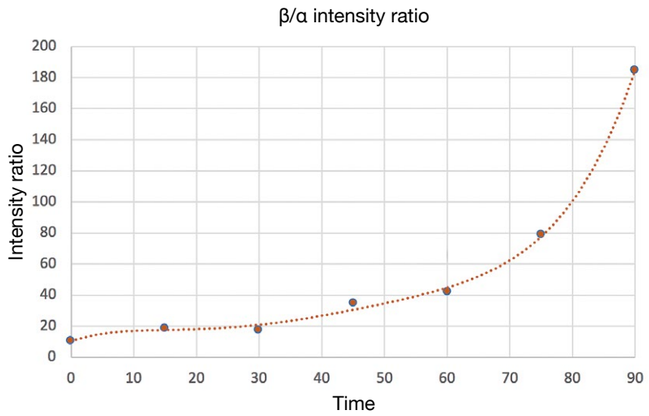


Figure 4.
As the α to β spodumene conversion proceeds, the β/α intensity ratio increases. The α and β intensities can be used to study the corresponding α and β spodumene concentrations and concentration changes. Note that temperature was not held constant during this conversion study (see fig 3).

Quantitative and qualitative measurements from solid process samples

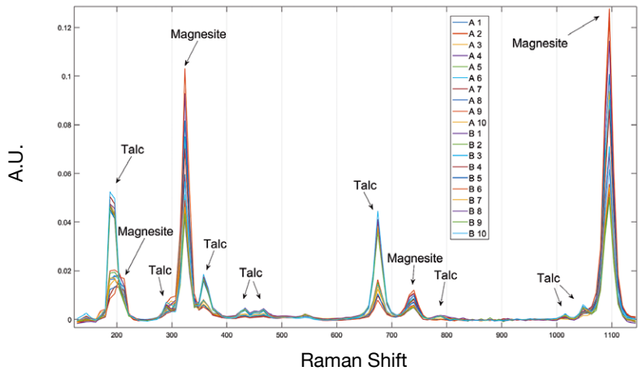


Figure 5.
Measured spectra from Mondo Minerals (Sotkamo, Finland) solid process samples. Timegated® Raman produces both qualitative and quantitative mineralogical information.

Sample	Determined Talc concentrations [m-%]
A 1	25.29
A 2	21.33
A 3	21.26
A 4	20.08
A 5	24.72
A 6	22.94
A 7	19.13
A 8	18.04
A 9	14.07
A 10	25.84
B 1	53.58
B 2	53.28
B 3	48.92
B 4	55.23
B 5	50.05
B 6	50.14
B 7	52.61
B 8	47.25
B 9	52.81
B 10	49.76

Table 1. The observed Raman signals can be used to calculate analyte concentrations.

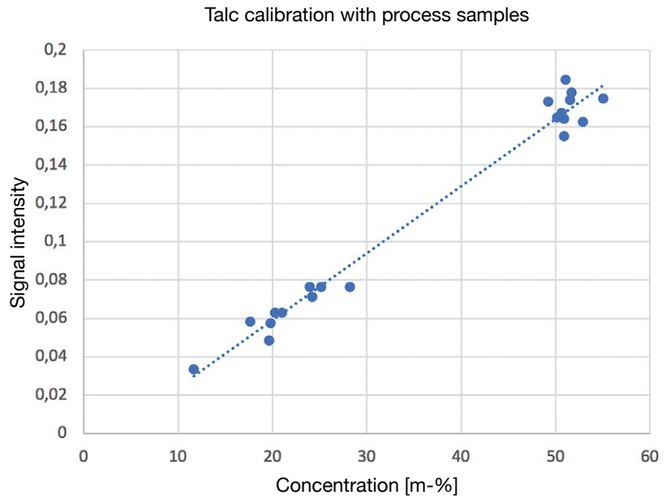


Figure 6.
Timegated® Raman enables robust quantitative measurements with mineral process samples. The final talc concentration results were in good agreement with the conventional labour intensive reference laboratory results.

REFERENCES:

[1] P. Tanskanen, P. Lamberg, O. Sirén, J. Takalo, L. Kurki, 2017, On-line monitoring of spodumene flotation with novel time-resolved Raman spectroscopy, Proceedings of the Process Mineralogy '17 Conference, Cape Town, South Africa

[2] P. Tanskanen, B. Heilala, L. Kurki, P. Lamberg, J. Savela, T. Fabritius, 2018 November, On-line monitoring of spodumene heat treatment process with time-gated Raman spectroscopy, Paper presented at Process Mineralogy '18 Conference, Cape Town, South Africa

timegate

ahead of time

Visiting address:

Timegate Instruments Ltd
Teknologiantie 5B
FI-90590 OULU, FINLAND
info@timegate.com
www.timegate.com

Find us on:

@TgiRaman

Timegate Instruments Ltd

Distributed by:

McCRONE MICROSCOPES & ACCESSORIES

mccrone.com | 630-887-7100
Email: mmaorder@mccrone.com

Supported by:

eit RawMaterials
Connecting matters

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation