CHRYSOS CORPORATION

Assays at the speed of light

Performance Note PN-003

Chrysos PhotonAssay™

Copper Services

PACU01: Copper Assay

Service Code: PACU01 (and related services)

System Settings: 40 s Irradiation, 40 s Measurement, 1 cycle, 12 MeV

Max Throughput: 72 samples/hour

Description: Copper assay. The performance is defined for characterised certified reference materials with low to zero concentration of interfering elements (see note below). The performance metrics are applicable to dry samples.

Copper Performance

Parameter	Typical Value
Limit of quantification, PACU01A	1000 ppm
Lower detection limit (2σ), PACU01	30 ppm
Grade offset (ppm), PACU01A	75 ppm
Grade offset (ppm), PACU01	*Specific to client materials*
Precision @ 0.05 wt %	5 %*
Precision @ 0.15 wt %	3 %*
Precision @ 0.5 wt %	2.5 %
Precision @ 1 wt %	2.5 %
Precision @ >2 wt %	2.0 %
Upper detection limit	4 wt %
Upper detection limit, PACU01H	30 wt %⁺

Precision percentages are reported at 1 SD.
* Precision on ore materials have been used where appropriate CRM data are unavailable.
⁺ For samples above 30 wt.% contact Chrysos for service information.

Interfering Elements

- Ge is an interfering element for the reference disc used in the Cu assay service. Elevated levels of Ge (>130 ppm) will flag “Interfering Element (IE)”. Copper values will not be reported.
- Pr, Ag, Sb, F, Zn, P and N can all interfere with copper analysis. Where possible, the presence of Pr, Ag, Sb, F and Zn is corrected for using secondary gamma-ray emissions. P and N do not produce any secondary gamma-rays, so nominal corrections are made for these elements based on their crustal abundances.

Material Characterisation

- An additional correction is often required to address the presence of interfering elements that cannot be explicitly identified by the PhotonAssay unit. The magnitude of this correction depends on the mineralogy of the samples being analysed.
- Chrysos has determined an average grade offset of 75±25 ppm (1-sigma), based on previous studies involving a range of copper deposits. This value is used for the uncharacterised PACU01A service.

- The limit of quantification for the PACU01A service is fixed at 1000 ppm, where the 2sigma uncertainty associated with using a generic grade offset is expected to be 5%.
- PACU01A will be offered as the default service prior to undertaking the programme of characterisation work specified in PRO-171 to tailor the grade offset for individual material streams.

Moist samples

- Substantially solid (non-liquid) samples with moisture levels up to approximately 30% can be measured.
- The PACU01 services do not determine moisture content, so grades are reported in as-received basis by default. Samples that have undergone prior analysis using the PAAU02M service (or equivalent) can be automatically corrected for their moisture content and grades reported in dry basis.
- Moisture calibration and hence impact on copper precision is site specific and depends on whether hydrogen is present in the sample in a form other than water that is released during drying.