METALLURGY

ALUMINIUM PRODUCTION

Reducing CO_2 in Al production

Rio Tinto is a global mining group that undertakes activities in extraction and processing of mineral resources.

THE PROBLEM TO SOLVE

The most common Aluminium (Al) production process - electrolysis or the Hall-Héroult process (Fig. 1) - emits a significant amount of CO_2. Rio Tinto's R&D departments are working towards finding more eco-friendly and economically viable solutions for the production of Al.

For the development of a new material for Al production, fundamental data on phase transformations at high temperature are needed. This may help optimise the parameters of new Al-production processes.

A STEP TOWARDS THE SOLUTION

Observation of a mixture of an oxide and a flouridated mineral at high temperature is of particular interest.

Rio Tinto's engineers, and a scientist at the Institut Laue-Langevin (France), prepared two samples that were heated up to the operating temperature, T_{op}, during continuous collection of diffraction patterns (Fig. 2, *in-situ* measurements).

THE RESULT

From the diffraction patterns, a measure of the lattice spacing for the oxide phase has been extracted and the slight shift in peak position could be linked with a loss of oxygen (Fig. 3). Another interesting finding was a rapid phase change at about 0.8 $T_{op.}$

Neutron diffraction allows the identification of rapid phase changes, as well as an evaluation of oxygen loss, whilst a high-temperature process is taking place.

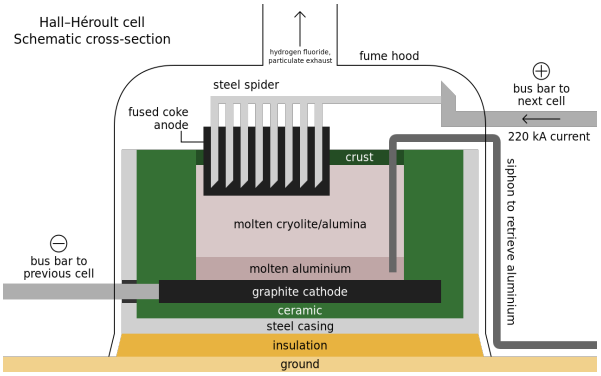

Fig.1 The Hall–Héroult process for aluminium electrolysis.
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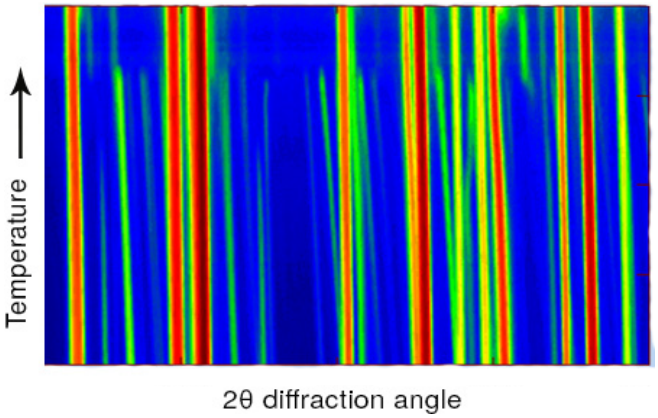

Fig.2 Diffraction data (the colours indicate intensity) obtained during the heating ramp (several hours) up to T_{op}. A well known phase transition occurs at 0.7 T_{op} as expected. The results here show several peaks that disappear and a new one emerging at about 0.8 T_{op}.

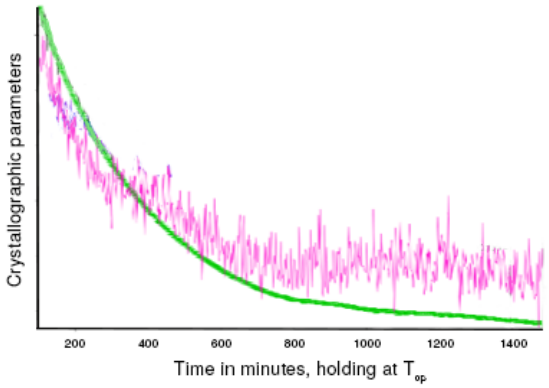

Fig.3 Evolution of refined crystallographic parameters during holding at T_{op}. The lattice parameter (green) decreases as well as the oxygen content (magenta).

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