AUSTRALIAN
critical
minerals
RESEARCH & DEVELOPMENT HUB

High Purity Alumina

The Australian Critical Minerals Research and Development Hub is investigating new pathways to produce High Purity Alumina. Using alternative feedstocks, researchers are developing new, lower-energy techniques with a reduced environmental impact. The project aims to capitalise on Australia's plentiful supply of aluminium-containing resources and develop intellectual property to help Australian companies take advantage of this emerging market

Why are we investigating processing techniques for High Purity Alumina?

High Purity Alumina, or HPA, is a refined form of aluminium oxide (α-Al_2O_3) that was added to Australia's critical minerals list in 2022. HPA is one of the key materials essential for the energy transition, with applications in LEDs, sapphire glass, catalysts, and lithium-ion batteries, where its growing use to coat separator sheets improves safety and battery life.

HPA purity starts at 99.99% (4N) to at least 99.9999% (6N) depending on requirements, and cost can exceed $70,000/t depending on grade. Its versatility is attributed to superior chemical stability, remarkable scratch resistance, and the ability to withstand extreme temperatures.

Currently, most HPA is produced from high purity aluminium metal, a very expensive feedstock. While aluminium metal provides a guaranteed route to high purity product, it essentially requires three industrial processes (bauxite refining, alumina smelting, and HPA production) each with their own high embodied energy and carbon footprints.

There is considerable interest in new production from cheaper starting materials for efficient value-adding and lower energy, more environmentally benign process pathways.

What are we doing?

CSIRO is undertaking a large fundamental R&D project on the production of HPA from diverse feedstocks, seeking to provide a step change in processing routes, product quality, techno-economics, and ESG standards.

Accurately quantifying extremely low levels of trace impurities is a key challenge when measuring HPA.

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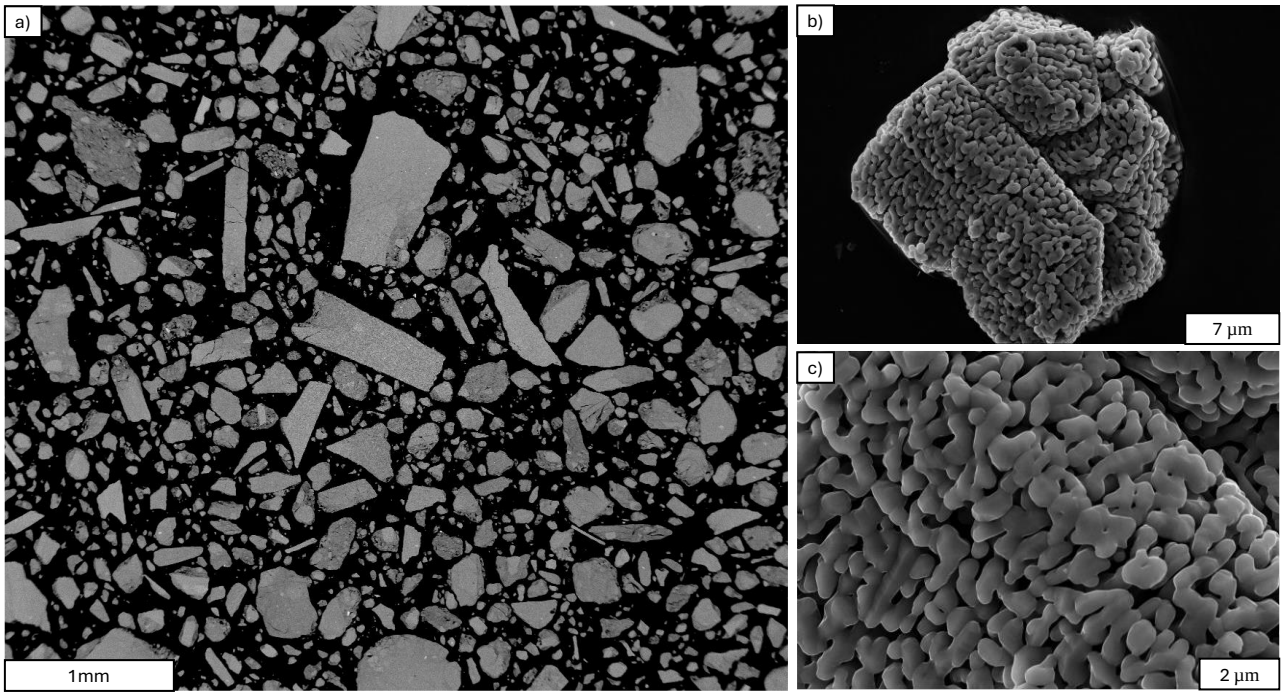

Scanning electron images of high purity alumina. a) cross-sectional view of 5N HPA. b) Single particle of 4N HPA and c) close-up region of particle shown in b). Images taken at CSIRO (Waterford site).

A second focus area is the characterisation of HPA product quality. The ability to accurately quantify low levels of trace impurities is important for the development of improved purification processes. To provide robust quality control and assurance, the detected level of impurity must be representative of the bulk concentration, reproducible within analytical error, and comparable to certified reference materials.

Our research aims to assess, adapt and develop analytical methods able to detect trace levels to provide a toolbox of techniques capable of benchmarking the quality of high purity materials. Making this capability available in Australia, to Australian HPA producers, would provide essential support to this emerging industry.

With Australia having significant potential to produce HPA to meet growing global demand, CSIRO is assessing the future onshore production potential of synthetic sapphire glass, an essential component in LED lighting systems and displays.

HPA companies have expressed an appetite to create an internal market for Australian HPA through the production of synthetic sapphire in Australia. The scope of the sapphire paper study covers the market opportunity, technical requirements, state-of-the-art technology and investment required, and R&D capability that needs to be established in Australia.

What is the aim?

The project aims to capitalise on Australia's plentiful supply of aluminium-containing feedstocks and to develop intellectual property to assist Australian companies to take advantage of this emerging market. This research is focussing on innovative approaches to purification typically associated with the production of HPA and that could also be applied to other critical minerals flowsheets. The project objectives are to:

- Process different feedstocks (mining waste/residue, industrial feedstock, and clays) to HPA to the economic advantage of Australian minerals projects
- Develop more efficient operating principles/procedures for HPA production
- Establish new analytical capability to benchmark HPA product quality.

This work has been supported by the Australian Critical Minerals Research and Development Hub whose activities are funded by the Australian Government.

Learn more

Contact us

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