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Producing aluminum oxide (alumina) from reaction of a gallium/aluminum alloy with water

Tech ID: 33501 / UC Case 2023-938-0

BACKGROUND

UC Santa Cruz investigators initially made a breakthrough discovery by which a gallium-rich alloy of gallium and aluminum containing aluminum nanoparticles that could be formed at relatively low temperatures (between 20 and 40 degrees C) could liberate nearly theoretical quantities of hydrogen in effectively any source of water (NCD 32779) through a chemical reaction requiring no outside electrical input and no corrosive byproducts.

One of the eventual useful byproducts of this reaction is alumina (aluminum oxide, Al₂O₃) a commodity chemical with a wide variety of uses in industry. This technology describes ways of further refining aluminum oxide from the products of this reaction.

TECHNOLOGY DESCRIPTION

The UCSC investigators discovered the surprising result that the actual byproduct of the reaction of the gallium/aluminum alloy with hydrogen at a temperature below 60 degrees was aluminum hydroxide, which in and of itself is a useful product.

If the initial hydrogen evolution reaction is carried out at a higher temperature (between 60 degrees and 100 degrees), aluminum oxyhydroxide is formed. Either aluminum hydroxide or aluminum oxyhydroxide can be heated to form aluminum oxide.

One potential use for the resulting aluminum oxide is to re-form aluminum. Any gallium remaining in the aluminum can be recovered and the aluminum can be recombined with gallium to re-form alloy, resulting in an entirely circular system.

APPLICATIONS

Refining useful aluminum hydroxide from the byproducts of the reaction of a gallium rich aluminum alloy with water.

Products include gallium doped aluminum hydroxide and gallium doped aluminum hydroxide. Both of these can be heated to form gallium doped aluminum oxide. The gallium doped aluminum oxide can be refined into aluminum and all gallium recovered.

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OTHER INFORMATION

KEYWORDS

aluminum oxide, alumina, aluminum hydroxide, aluminum oxyhydroxide, aluminum, circular process

CATEGORIZED AS

- ▶ **Energy**
 - ▶ Hydrogen
- ▶ **Materials & Chemicals**
 - ▶ Nanomaterials
- ▶ **Nanotechnology**
 - ▶ Materials

RELATED CASES

2023-938-0, 2019-755-0

ADVANTAGES

Produces aluminum hydroxide by the cleanest method known, which can eventually be refined into aluminum (along with gallium in the aluminum oxide).

The remaining gallium and refined aluminum can be combined with recovered gallium from the initial hydrogen producing reaction, to reproduce the original gallium rich aluminum alloy, resulting in a fully circular hydrogen production system.

INTELLECTUAL PROPERTY INFORMATION

Country	Type	Number	Dated	Case
Patent Cooperation Treaty	Published Application	WO 025/155514	07/24/2025	2023-938

RELATED MATERIALS

- ▶ [Gallium Nanoparticle Formation and Doping of Nanocrystalline Alumina from a Ga–Al Liquid Metal Hydrogen Generating Reaction](#) - 10/30/2023

RELATED TECHNOLOGIES

- ▶ [Efficient Hydrogen Evolution From Water via an Alloy Containing Aluminum Nanoparticles](#)

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

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