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Rapid carbon-free iron ore reduction with high-density hydrogen plasma

A new method of using hydrogen plasmas for rapid and carbon-free iron ore reduction using micron and submicron-sized iron ore particles.

IP Status: Provisional Patent Application Filed

Applications

- Steel production
- DRI (Direction Reduction of Iron) process in Battery Industry

Key Benefits & Differentiators

- Carbon neutral iron ore reduction process.
- High percentage reduction (Over 90%)
- Faster iron ore reduction process (in less than 0.1 seconds, which is about 100 times faster than other approaches to date.)
- Plasma reduction may be agnostic to the type of iron ore. This technology may enable the use of ores that are currently not being mined such as hematite.

Technology Overview

Iron ore reduction is essential for steel production, which accounts for about 8% of global CO2 emissions, due to the use of fossil fuels (such as coking coal) as reductants. The steel industry strives to reduce CO2 emissions from steel making by 50% by 2050. Currently, only ore with a large magnetite (Fe3O4) content is used, while hematite (Fe2O3) is discarded since there is a lack of technology to reduce it in an efficient way.

Researchers at the University of Minnesota have developed a rapid, carbon-free reduction method of iron ore in hydrogen plasmas. Different from a conventional reduction in blast furnaces, hydrogen plasma reduction is carbon-free when performed with renewable electricity, and when hydrogen is produced by electrolysis with renewable electricity. This work reports a reduction of small iron ore particles in hydrogen plasma in less than 0.1 seconds, which is about 100 times faster than other approaches to date. The plasma process charges particles negatively while in flight; the reactor walls are also negatively charged, hence, particles are repelled from the reactor walls and do not stick to the walls, which is a common problem in thermal approaches. This technology also yields a high percentage reduction of more than 90% at the same time being a carbon-free process. Additionally, this technology might have the potential to be agnostic to the type of the ore and be applicable for hematite reduction as well.

Phase of Development

TRL: 3-4
Working prototype in a lab environment.

Desired Partnerships

This technology is now available for:

Technology ID
2022-244

Category
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Engineering & Physical Sciences/Processes
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References

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