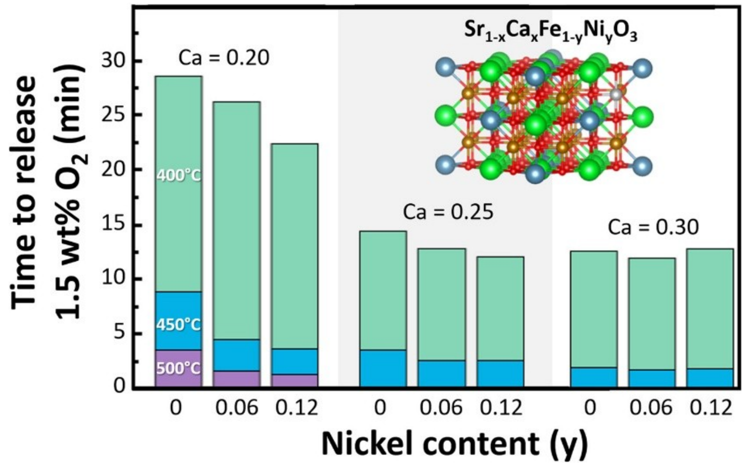
TECHBRIEF

NETL Ref. No: 20N-20

Perovskite Oxygen Carriers for Efficient, Modular O_2 Supply



Opportunity

The U.S. Department of Energy's National Energy Technology Laboratory (NETL) has developed customizable mesoporous perovskite oxygen carriers (O_2 carriers) based on $Sr_{1-x}Ca_xFeO_3$, with optional nickel substitution at the B-site. These materials reversibly adsorb and release oxygen at moderate temperatures enabling compact, modular oxygen supply systems for industrial and decentralized applications without the need for cryogenic separation. The carriers are synthesized through a scalable polymerized metal-carboxylate route, calcined at relatively low temperatures (650–850 °C), and exhibit surface areas between 2 and 9 m^2/g. This invention is available for licensing and/or further collaborative research from NETL.

Problems Addressed

- Cryogenic oxygen production is costly, energy intensive and unsuitable for distributed use.
- Conventional oxygen carriers often require high operating temperatures, have slow kinetics or depend on cobalt.
- Many industrial and medical applications need on-site oxygen buffering or separation that is flexible and efficient.

Potential Commercial Applications

- Modular air separation for industry: oxygen for glass, metals, pulp and paper, and hospitals.
- Oxy-combustion and chemical looping: improved efficiency and CO_2 capture capability.
- Process intensification: on-demand oxygen for reformers or oxidation reactors.

Competitive Advantages

- Nickel substitution improves oxygen release kinetics by approx. 75%compared to undoped perovskites.
- Cobalt-free composition lowers cost and reduces reliance on critical materials.
- Scalable synthesis is suitable for powders, pellets or structured supports.

Intellectual Property Status

Patent pending via PCT Application No.: US20230338920A1.

Publications

E. Popczun, …, J. Lekse. (2024). Porosity in Sr1-xCaxFeO3-δ oxygen carriers: The role of surface area and pretreatment on storage activity. *J. Alloys Compd.* DOI: https://doi.org/10.1016/j.jallcom.2024.173526

E. Popczun, …, J. Lekse. (2022). Nickel B-site substitution in bulk Sr1−xCaxFeO3 perovskite oxygen carriers: Benefits and limitations. *J. Alloys Compd.* DOI: https://doi.org/10.1016/j.jallcom.2021.162783

Licensing

Partnerships@netl.doe.gov

Inventors

Jonathan Lekse, Eric Popczun, Sittichai Natesakhawat and Christopher Marin