Picolinate-Based Acyclic Ligand for Rare Earth Extraction and Separation

Tech ID: 34555 / UC Case 2025-383-0

BACKGROUND

Rare earth elements (REEs) are critical materials used in advanced technologies including electronics, renewable energy systems, and defense applications. However, their extraction and separation remain challenging due to their similar chemical properties and the environmental impact of conventional processing methods. Chelators, specialized molecules that selectively bind to metal ions, play a crucial role in improving the efficiency and sustainability of critical mineral and rare earth extraction. Traditional chelation methods often involve toxic reagents and costly processes, prompting the need for innovative, eco-friendly alternatives. The development of a novel chelator with enhanced selectivity, stability, and recyclability could significantly optimize rare earth recovery, reducing both costs and environmental footprint while ensuring a more sustainable supply of these essential materials.

DESCRIPTION

Researchers at the University of California, Santa Barbara have formulated a novel picolinate-containing acyclic chelator designed for efficient, selective, and eco-friendly extraction and separation of rare earth elements. This innovative acyclic chelator, H2aapa, is synthesized via a four-step reaction with a high yield, affording better cost-efficiency compared to representative cyclic macropa, while presenting the unique reverse-size selectivity for REEs. It offers enhanced selective binding affinity for light rare earth elements over heavy ones, using a picolinate-based structure, and it enables superior extraction and separation of rare earth elements from spent solid materials, facilitating sustainable hydrometallurgical processes and recycling with reduced environmental impact.

ADVANTAGES

- High selectivity for light rare earth elements, enabling more precise separation
- Reverse-size selectivity not previously common in acyclic chelators
- Cost-efficient synthesis with high yield compared to traditional cyclic ligands
- Enhanced binding stability improves extraction performance
- Environmentally friendly alternative to toxic, conventional methods
- Supports recyclization and sustainable recovery of rare earth elements

APPLICATIONS

- Extraction and separation of rare earth elements from secondary or spent materials
- Advanced electronics manufacturing, requiring purified rare earth inputs

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OTHER INFORMATION

KEYWORDS

rare earth elements, REEs, light rare earth elements, picolinate-containing acyclic chelator, acyclic chelator, chelator, picolinate, renewable energy, Hydrometallurgical, electronics

CATEGORIZED AS

- **Energy**
  - Other
  - Wind

RELATED CASES

2025-383-0

- Renewable energy technologies such as wind turbines and electric vehicles
- Defense applications relying on rare earth components
- Hydrometallurgical processing and sustainable mining operations

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- Radio-Metal Trioxo Complexes for Bioorthogonal Click Cycloaddition in Targeted Radionuclide Therapy and Imaging

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