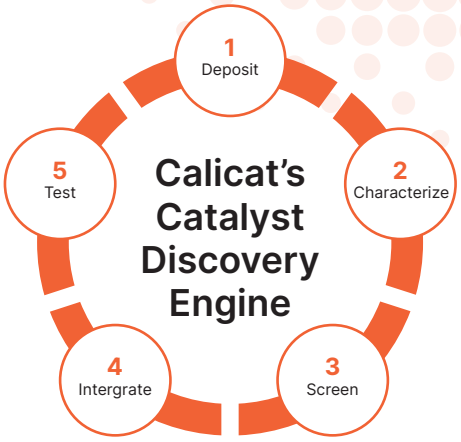
Calicat

Catalyst Discovery Engine™ (CDE™)

Accelerating catalyst technology for the hydrogen economy

The Catalyst Discovery Engine

The Calicat CDE is a data-driven high-throughput screening process that allows scientists to rapidly make, characterize, and quantify the catalytic activity of material compositions and then close the loop with big data analysis and artificial intelligence. Within the current decade, conservative projections call for 100+ GW of new installed electrolyzer capacity. This high growth rate necessitates rapid advances in research and development, including catalytic efficiency and scalability. Using its patented CDE, Calicat has discovered novel catalyst materials that can mitigate supply chain risks in the production of low-cost renewable hydrogen at large scales. Calicat has expanded this technology beyond PEM water electrolysis to AEM catalyst development and other crucial technologies in the hydrogen economy. Partner with us to leverage cutting edge research and a skilled team to develop next-generation catalysts for your technology.



Electrocatalyst Discovery Process

The technology and IP forming the core of the CDE were developed over 10 years at the California Institute of Technology (Caltech) through a $122M Department of Energy (DOE) grant. This iterative process occurs in five key steps, outlined below.

First, arrays of potential catalyst compositions are prepared by one of two different methods: drop-on-demand solution dispensing or physical vapor deposition. Each spot in the resulting catalyst array consists of a distinct composition of matter. Methods are available for depositing essentially any combination of up to six elements at a time, allowing our scientists to rapidly explore the periodic table for potential catalyst hits. These combinatorial arrays can then be annealed under a variety of conditions and environments to produce a broad catalogue of potential catalyst candidates. Each catalyst spot is characterized via high-throughput X-Ray Fluorescence to precisely determine the composition and mass loading of the target materials.

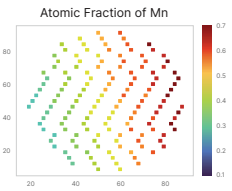
DEPOSIT

Materials Synthesis of Combinational Arrays

Drop on Demand | Combinational PVD | Catalyst Array

CHARACTERIZE

Quality Assurance via XRF



The validated catalysts are screened for their catalytic activity using Calicat's patented Scanning Droplet Cell (SDC). The SDC screens catalyst materials faster than any other known technique, making it a highly valuable tool in the ongoing search for PGM replacements. Using this method, Calicat scientists can rapidly analyze an entire plate of hundreds of catalyst materials in a few hours, and investigate tens of thousands of samples per month. The data from each experiment then guides and informs subsequent searches for electrocatalyst candidates. The SDC enables Calicat researchers to study catalysts for reactions in various relevant environments including PEM water electrolysis and fuel cells, and anion exchange membrane (AEM) environments.

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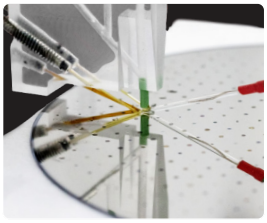
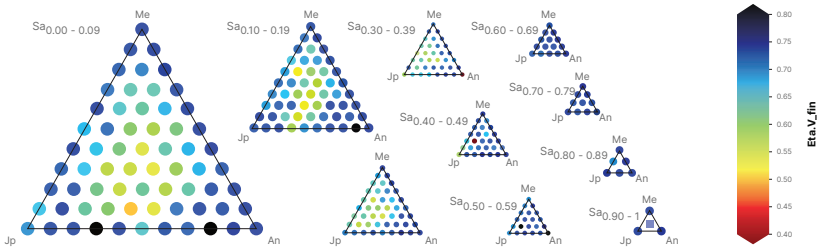
Calicat
Catalyst Discovery Engine™

SCREEN



The Scanning Droplet Cell

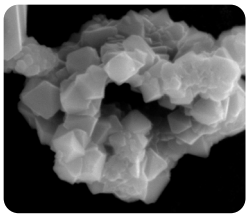


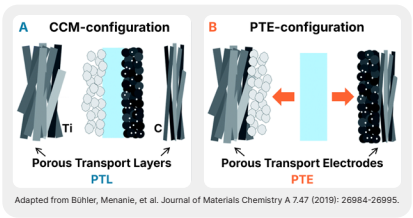
Materials Integration

In an electrolyzer, materials integration is often as important to catalyst performance as the material itself. Because of this, Calicat has designed a holistic process that begins with catalyst discovery and ends with materials testing in an electrolytic testbed. Promising catalyst candidates are synthesized as nanoparticles in house in small batches. These catalysts are optimized for structure, size, and morphology and incorporated into electrolytic cells using various techniques to optimize performance and durability. The integrated materials are then evaluated in one of Calicat's Catalyst Test Stations to validate catalyst performance in real-world operating conditions.

INTEGRATE

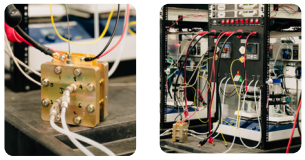
Nanoparticle synthesis and Integration





TEST

Catalyst Test Station



Benefits and Opportunities

The Calicat proprietary catalyst discovery process offers unparalleled ongoing support for performance improvement. With these rapid-screening tools, Calicat can optimize materials over key performance parameters including cost, efficiency, and durability. These parameters are verified and benchmarked against our advanced LCOH model to determine which properties maximize value. Leveraging this technique, Calicat scientists have discovered multiple families of catalyst materials that could replace rare, expensive metals like Iridium. Undertaking catalyst discovery with Calicat presents an opportunity to leverage Calicat's unique and proprietary CDE to discover and evaluate new catalyst compositions and collaborate to test these materials in commercially relevant conditions. Together, we can develop next-generation catalysts and materials to grow the hydrogen economy.

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