Make the right move with NanoSelect™ Catalysts
BASF proudly presents its NanoSelect™ technology platform, featuring NanoSelect LF 100 and NanoSelect LF 200 as the eco-friendly alternatives to classical Lindlar catalyzed hydrogenation processes. Lindlar catalysts are lead-modified heterogeneous palladium catalysts typically used in highly selective hydrogenation reactions. Unfortunately, the lead additive also causes Lindlar catalysts to face regulations that restrict their manufacture and use due to toxicity.

NanoSelect LF 100 and LF 200 catalysts are characterized by unimodal metal particles on the nanometer scale. Nanotechnology is science and controlled engineering on the scale of nanometers (billionths of a meter). Reducing the size of metal particles to nanometers:
- Greatly increases the metal surface area available per gram.
- Boosts the catalytic activity.
- Demonstrates different catalytic behavior.

Figure 1: A Transmission Electron Microscope photo of unsupported NanoSelect palladium-colloids.

BASF Catalysts used these basic principles to develop an innovative, patented technology named NanoSelect. This technology utilizes a BASF reagent to combine reducing and stabilizing functions that produce highly unimodal, nanosized metal colloids (Figure 1). These colloids can be deposited onto different support materials giving heterogeneous catalysts with unique and surprising catalytic behaviors.

NanoSelect LF 100 and LF 200 heterogeneous catalysts from BASF are lead-free, green alternatives to the classic Lindlar catalysts for highly selective hydrogenation reactions.
NanoSelect LF 100 and LF 200 catalysts are based on different supports and contain only 0.6 or 0.5 wt% of palladium, respectively. This differs greatly from Lindlar catalysts, which contain around 5 wt% palladium.

NanoSelect provides superior performance without lead and with less precious metal content

For example, when compared to the Lindlar catalysts in the selective hydrogenation of 3-hexyn-1-ol to the corresponding alkene (Figure 2), the NanoSelect LF 200 catalyst, with vastly less metal content and no lead content, exhibit similar activity and selectivity.
NanoSelect LF 100 and LF 200 vs. Lindlar Catalysts

<table>
<thead>
<tr>
<th>LF 100 and LF 200</th>
<th>Lindlar</th>
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<tbody>
<tr>
<td>Lead-free is environmentally friendly</td>
<td>Lead additives are toxic to the environment, and are heavily regulated in manufacture and use</td>
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<tr>
<td>Palladium content of 0.6 or 0.5 wt% greatly reduces process cost</td>
<td>Palladium content of 5 wt% significantly contributes to high process cost</td>
</tr>
<tr>
<td>High selectivity</td>
<td>High selectivity</td>
</tr>
<tr>
<td>Good activity</td>
<td>Good activity</td>
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Enabling efficient process economy and saving you money

When selecting a catalyst for a hydrogenation, the following factors must be considered:

- Catalyst productivity versus total cost of the process.
- Cost of the apparatus to maintain or apply a high pressure.
- High selectivity towards the desired product versus high process productivity.

NanoSelect LF 100 and LF 200 catalysts offer equivalent or greater hydrogenation activity to Lindlar catalyst (Figure 2) with no lead content and an order of magnitude less metal (0.5 wt% compared to 5 wt%). With less metal in the catalyst the cost of the process decreases significantly.
Controlled Flexibility with NanoSelect Technology

BASF NanoSelect vs. Other Commercial Catalysts

<table>
<thead>
<tr>
<th>BASF NanoSelect</th>
<th>Other Commercial Catalyst</th>
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<tbody>
<tr>
<td>Narrow metal crystallite size distribution</td>
<td>Broad Metal Crystallite size distribution</td>
</tr>
<tr>
<td>Protective Organic Shell</td>
<td>Unprotected Metal Crystallites</td>
</tr>
<tr>
<td>Interaction between support and stabilizer</td>
<td>Interaction between support and metal</td>
</tr>
<tr>
<td>Large-scale Production</td>
<td>Large-scale Production</td>
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</table>

Pd core with protective organic shell
Why BASF?

Our goal is to make our customers successful. This is accomplished by our constant passion for innovation, enabling enhanced economics, and increased productivity. In industry, we are a partner for the future with our extensive expertise of both catalysts and processes.

Service

At BASF, we know that our success is dependent upon your success. That is why we are dedicated to offering intelligent system solutions, supported by our outstanding customer and technical assistance. An analysis of your current processes will reveal the BASF products and services that will greatly improve your efficiency and bottom line.
About us

BASF’s Catalysts division is the world’s leading supplier of environmental and process catalysts. The group offers exceptional expertise in the development of technologies that protect the air we breathe, produce the fuels that power our world and ensure efficient production of a wide variety of chemicals, plastics and other products. By leveraging our industry-leading R&D platforms, passion for innovation and deep knowledge of precious and base metals, BASF Catalysts develop unique, proprietary catalyst and adsorbent solutions that drive customer success.

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NanoSelect Technology for controlled flexibility is the proud recipient of the 2009 Frost & Sullivan North American Nanocatalysts Green Excellence of the Year Award

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