Theme Name	Polymer-sheet supported palladium hydride catalyst
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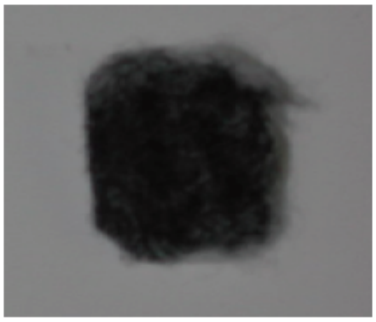
Technical field	Environmental / Organic Chemistry / Inorganic Chemistry

Abstract

We are studying new hydrogenation catalysts using palladium.
1)Hydrogenation without hydrogenolysis reaction, 2) partial hydrogen addition with a selectable number of substitutions, 3) repeatable use (reuse), 4) reduction (reuse) of catalyst usage, 5) easy recovery and reactivation (recycling), 6) low flammability, 7) easy mass production, and 8) low cost can be achieved with the technology. Application to organic synthesis reaction, denitration catalyst (NOx reduction and removal), desulfurization catalyst, electrode material, etc.is possible. We welcome companies that want to make practical use of this technology and technical consultation on organic synthesis / catalysts.

Schematic Image

Polymer-Sheet supported palladium hydride catalyst



(After catalyst formation)

(Polymer sheet:
Before catalyst formation)

【Features】

- Hydrogenation without hydrogenolysis
- Partial hydrogen addition with a selectable number of substitutions
- 3R
  - —Reuse (reduction of catalyst consumption)
  - —Reduce (repeatable use)
  - —Recycle (Easy recovery/reactivation)
- Low flammability / Safety
- Durability
- Easy mass production
- Low Cost

【Applications】

Organic synthesis (Hydrogenation reaction, multistage synthesis, etc.)	Denitration catalyst (Nox, Sox, etc.)
Desulfurization catalyst (Petroleum, fuel, etc.)	Electrode material

Background

The reaction of adding a hydrogen atom to a compound using hydrogen gas as a reducing agent is called a hydrogenation reaction. The reaction is used for a variety of applications such as deprotection of benzyl groups in organic synthesis, hydrogenation of hydrogen, catalytic reforming of petroleum, synthesis of ammonia by hydrogenation of nitrogen, and synthesis of methanol by hydrogenation of carbon monoxide.

However, the hydrogenation reaction usually uses catalysts, but it has drawbacks that the catalyst is in a powder form which makes it difficult to use for organic synthesis other than deprotection.

In this technology, we propose a new hydrogenation catalyst that solves the above problems.

Technical Content

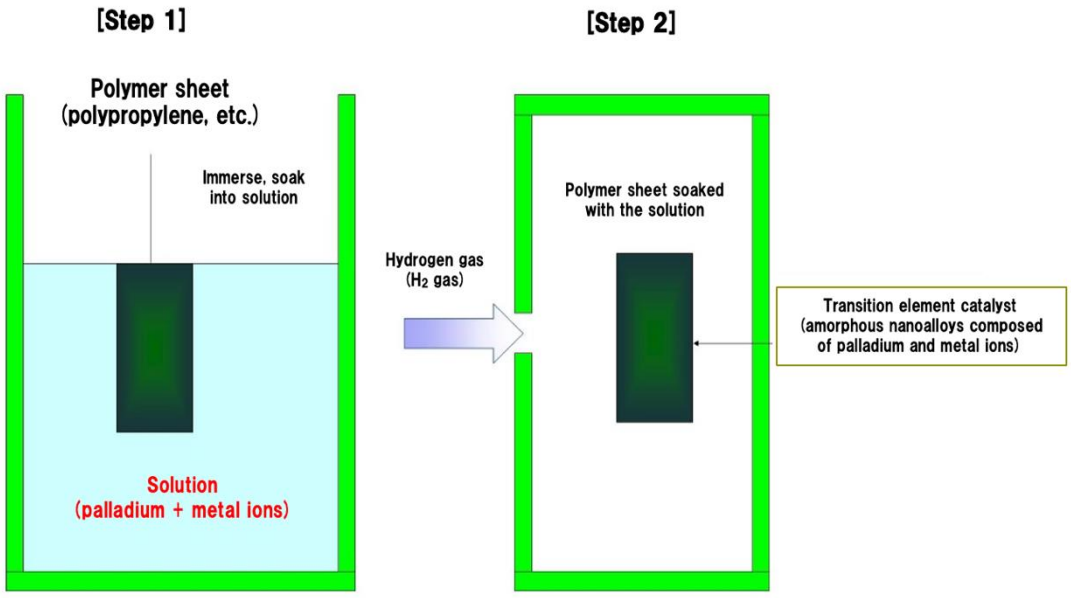
This is a technology that generates a hydrogenation catalyst with a new function. The principles are as follows. The fact that the metal catalyst is supported on a polymer sheet instead of in a powder form is greatly different from the existing technology.

1) Make a solution containing palladium and metal ions (platinum, rhodium, iridium, ruthenium, or rhenium.)

2) Immerse a polymer sheet into the solution and let the solution soak in.

3) Place the polymer sheet soaked with the solution in a hydrogen gas atmosphere.

4) A transition element catalyst is formed in a polymer sheet.
The transition element catalysts are amorphous nanoalloys composed of palladium and metal ions, and are highly active.



Strengths of technologies and know-how (novelty, superiority, utility)

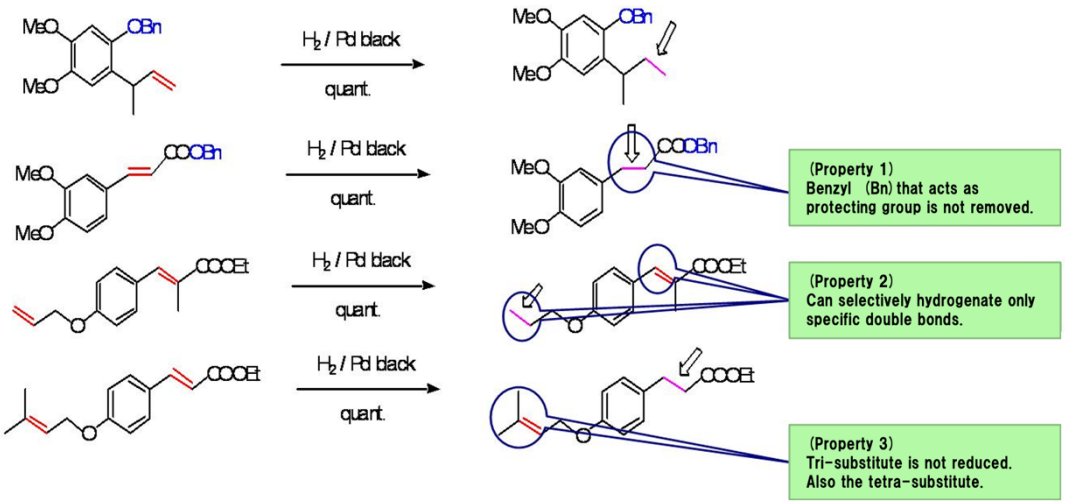
The advantages of the hydrogenation catalysts are as follows.

1) Hydrogenation reaction without hydrogenolysis reaction .

- In organic synthesis, the benzyl group (protection) may be removed (deprotection) when a hydrogenation reaction is performed (called hydrogenolysis).
  With this technology, hydrogen can be added only to the necessary parts for hydrogenation, so that the protective group is not removed.

2) Partial hydrogen addition with a selectable number of substitutions.

- It is possible to selectively reduce mono- and di- substituted double bonds without reducing tri- and/or tetra- substituted double bonds.



3) Repeatable use (reuse)

— Usually, the palladium hydrogenation catalyst is in the form of powder. After the reaction, it is removed using a filter such as a filter paper or Celite, that it used up every time.

In this technology, the catalyst is not a powder type but rather a cotton type that it is not necessary to remove after every reaction.

For this, it can be used repeatedly until it becomes inactive.

4) Reduction of catalyst usage (reduce)

—Polypropylene non-woven fabric has excellent reactivity as it easily absorbs organic solvents and the effective surface area of the catalyst expands.

A sufficient effect can be obtained using only a small amount of catalyst.

5) Easy recovery and reactivation (recycle)

— Since the catalyst is fixed to non-woven fabric, it is easy to recover and reactivate.

6) Low flammability

—Ignition properties are a big problem in the powder type.

This technology has low flammability and hence is excellent in safety.

It does not ignite even when it is dried with hot air such as dryer.

7) Durability

—The catalyst material is fixed to the inside of the non-woven fabric that it does not easily come off due to physical contact and has excellent durability.

8) Easy mass production

—The process is very simple, only immersing a non-woven fabric into a solution and keeping it in hydrogen gas.

— The amount of catalyst carrier can be easily controlled by the concentration and volume of the solution absorbed in nonwoven fabric.

—No special equipment is required.

9) Low cost

—As 3R (reuse, reduce, recycle) is possible, mass production is easy, and non-woven fabric that acts as carrier is made of inexpensive polypropylene, the overall cost is low.

Image of partner companies

We welcome companies that wish to commercialize this technology.
For example, we can partner with the following companies.

1) Companies that use hydrogenation catalysts, but wish to reduce costs by reducing catalyst consumption, performing repeated use, recycling, etc.
2) Companies that use hydrogenation catalysts but have a problem with the ignition.
3) Companies conducting research on organic synthesis (especially multi-stage synthesis.)
4) Companies researching or exploring on denitration catalysts.
5) Companies researching or exploring on hydrogenation catalysts.
6) Companies that are facing problems in hydrogenation reactions.
7) Companies researching on electrode materials
8) Companies willing to develop a new business based on new catalyst technologies.

Utilization of technologies and know-how (images)

The technology can be applied to various uses related to hydrogenation reactions. For example, the following applications are possible.

1) Multi-stage organic synthesis reaction

In multi-step organic synthesis, partial hydrogenation is possible without removing protecting groups. Furthermore, by selectively hydrogenating only the parts with the desired number of substitutions, it is possible to realize an organic synthetic reaction that has not been possible until today.

2) Denitration catalyst

As a NOx, SOx catalyst, it can be applied to purification of gas exhaustion from automobiles, thermal powerplants, and large boilers. Long-term use can be expected as a highly durable material (carbon felt, etc.) has been used. (Evaluation research such as safety test is necessary.)

3) Desulfurization catalyst

Petroleum distillates containing impurities such as sulfur can be removed by reacting with hydrogen in the presence of a catalyst.

4) Electrode materials using catalysts

The product can be applied as an electrode material by carrying it on carbon felt.

Flow of technology and know-how

The prototype is already available. After your inquiry, we will explain the detailed technical contents at the technical meeting. We can also provide technical consultation on organic synthesis and catalysts not limited to this technology.

Description of technical terminologies

[Denitration]

The removal of nitrogen oxides from exhaust gases of automobiles and boilers, etc.

[NOx (nitrogen oxide), SOx (sulfur oxide)]

NOx is harmful to the human body, and is the cause of air pollution, the greenhouse effect, and the destruction of the ozone layer. SOx is a also

harmful substance that causes air pollution and acid rain. Both have been addressed in recent years as targets of environmental regulations.

[Desulfurization]

In the petroleum industry and gas industries, desulfurization refers to the removal of sulfur content, which has harmful effects on raw materials and products. Especially in the case of gasoline, the lead additive effective decreases when the sulfur content is high. In the case of heavy oil, harmful sulfur dioxide gas may be generated during combustion, causing pollution.