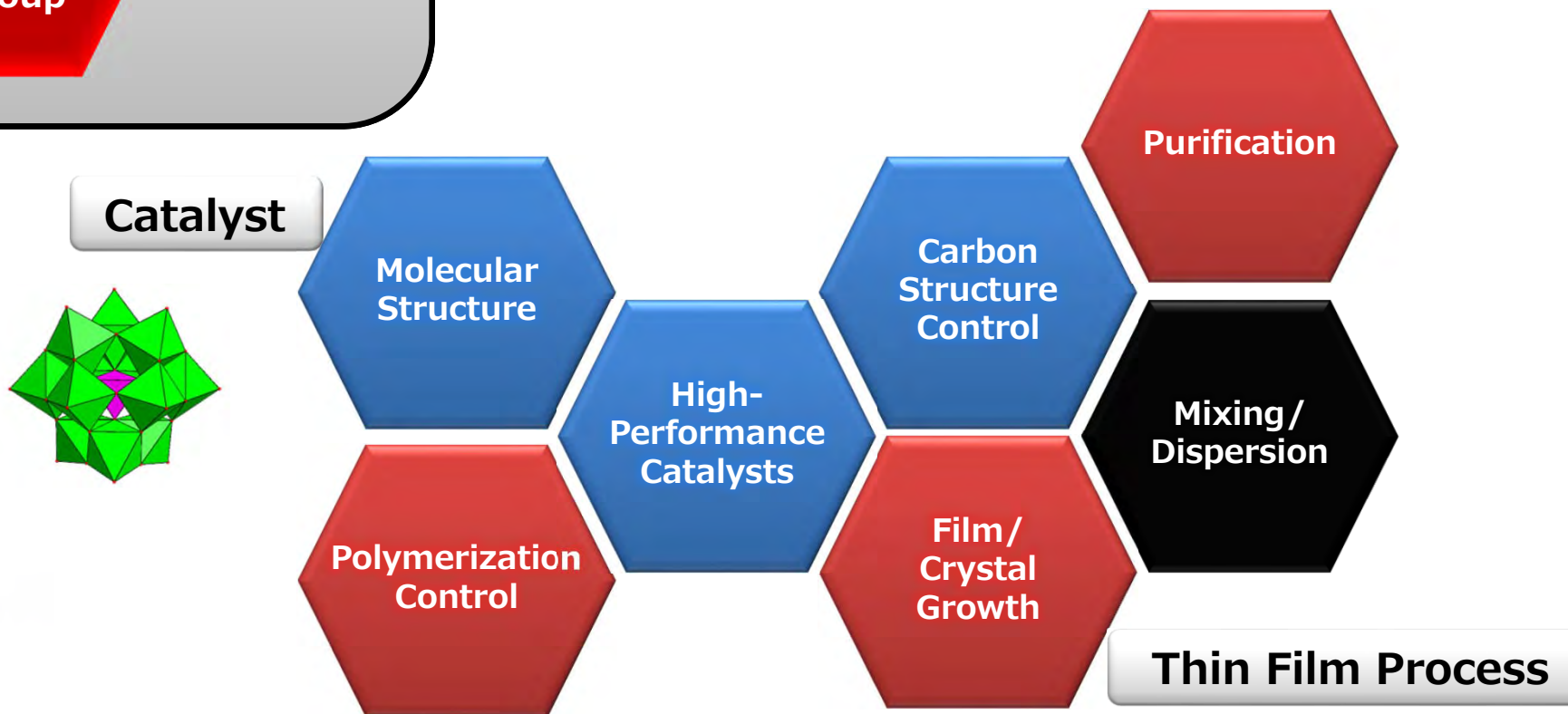
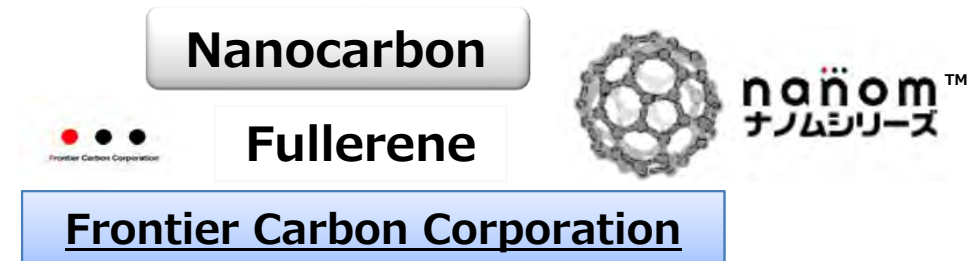
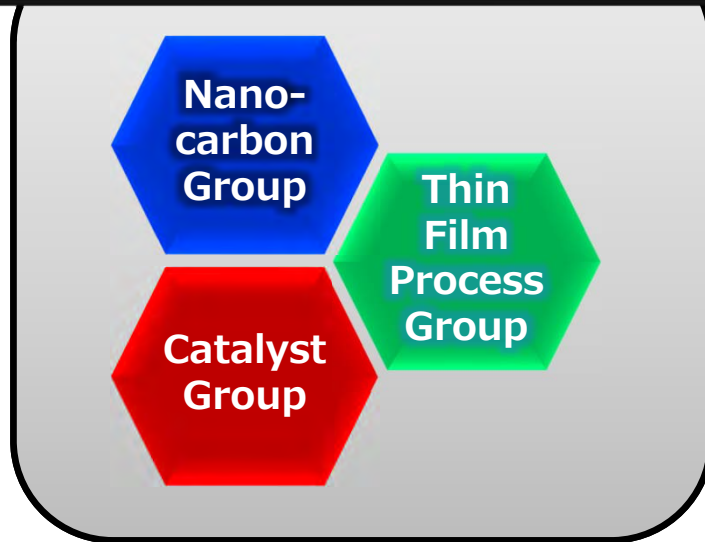


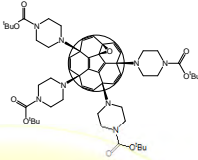
Institute for Advanced and Core Technology



Product examples



Fullerene



Sports gear

Golf clubs, rackets, etc.

Semiconductors

Nano lithography, material for lower films

Energy

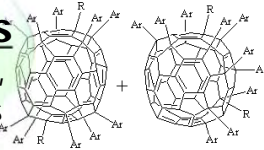
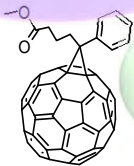
Organic photovoltaic panels, fuel cells

Lubricants

Additive to lubricants, waxes, etc.

Other industrial uses

Additives to polymers, rubber, and metal; hard carbon films



Frontier Carbon Corporation

Mitsubishi Corporation

Mitsubishi Corporation

© World-class sales and marketing capabilities

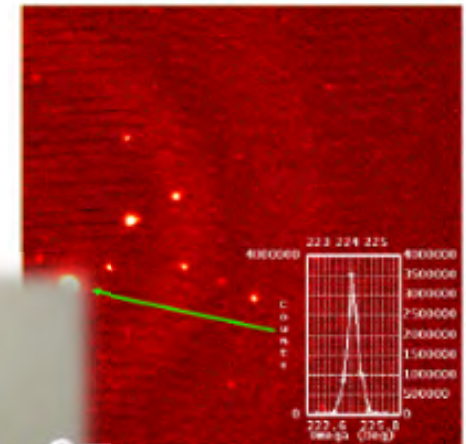
SHOWA DENKO

Showa Denko K.K.

© Nano carbon technology
© Able to develop, produce, and supply new products satisfying customers' requirements

Our technologies

- High-temperature reaction control technology
- Separation and refinement technologies
- Organic synthesis technology
- Vacuum processing technology
- Fine particle treatment technology
- Crystallization technology
- Dispersion technology
- Measurement and evaluation technologies
- Surface analysis technology
- Chemical reaction simulation technology



Fullerene products

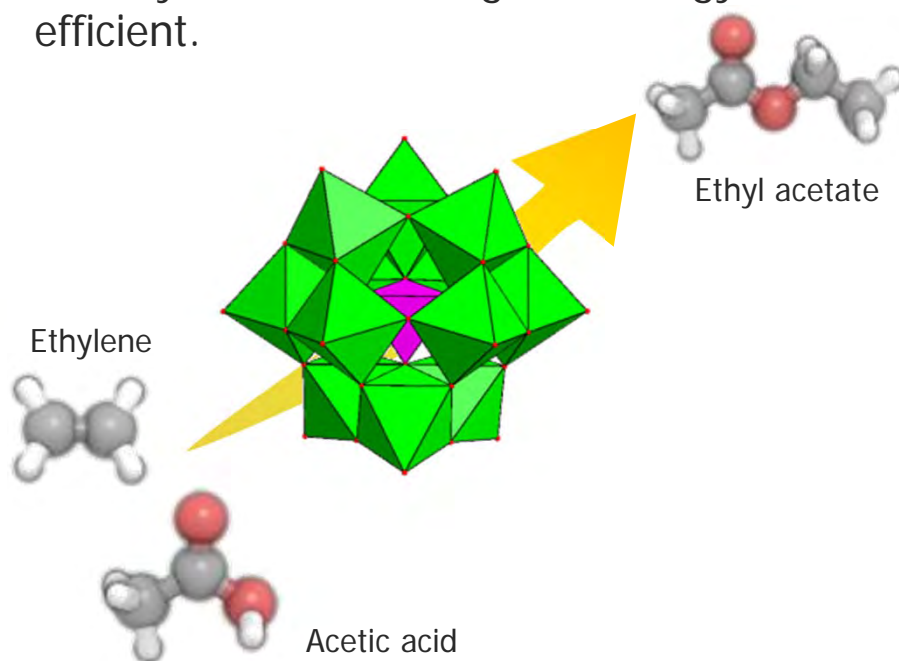
Product example

■ Catalyst for Ethyl acetate

Using the **supported heteropoly acid catalyst** jointly developed with a university, we have produced ethyl acetate from ethylene and acetic acid in one stage.



Since few by-products are generated during this reaction, the production method is eco-friendly, resource saving and energy efficient.



Our technologies

■ Acetyl catalyst technology

We have technologies for catalyst design, catalyst analysis, catalyst performance evaluation, and plant operation for the following reaction processes:

- Ethylene + Oxygen → Acetic acid*
- Ethylene + Acetic acid → Ethyl acetate*
- Ethylene + Acetic acid + Oxygen → Vinyl acetate
- Propylene + Acetic acid + Oxygen → Allyl acetate
- Allyl acetate + Hydrogen → N-Propyl acetate

* Received the Minister of Economy, Trade and Industry prize of the Green & Sustainable Chemistry (GSC) Award (2007)

■ Porous coordination polymer (PCP)

PCP is a porous crystalline material formed by coordination bonds, and PCP with a flexible structure can be used for gas separation. We are developing a wide range of technologies from ligand synthesis to formation, with a view to commercialization in the PSA process.

