

Fine particles for a fine future.



TODA KOGYO CORP.

## Hydrotalcite

(Layered double hydroxides  
of Mg/Al and carbonate type)

# Hydrotalcite

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**Hydrotalcite** is a kind of naturally yielded clay mineral. The typical chemical composition is a carbonic acid type, and the composition is  $Mg_6Al_2(OH)_{16}CO_3 \cdot 4(H_2O)$ . **TODA KOGYO artificially synthesizes hydrotalcite.**

Hydrotalcite is generally represented layered double hydroxides (LDH) of Mg/Al and carbonate type. Anions such as chloride ion ( $Cl^-$ ) are adsorbed by ion exchange with carbonate ion ( $CO_3^{2-}$ ) between Mg/Al type layers. In addition, the contained carbonate ion ( $CO_3^{2-}$ ) absorbs infrared rays and exert a heat storage and heat retention effect. Hydrotalcite also have other functions such as water adsorption or an acid adsorbent for rubber containing halogen.

**TODA KOGYO's hydrotalcite** has been used for the following applications by taking the features.

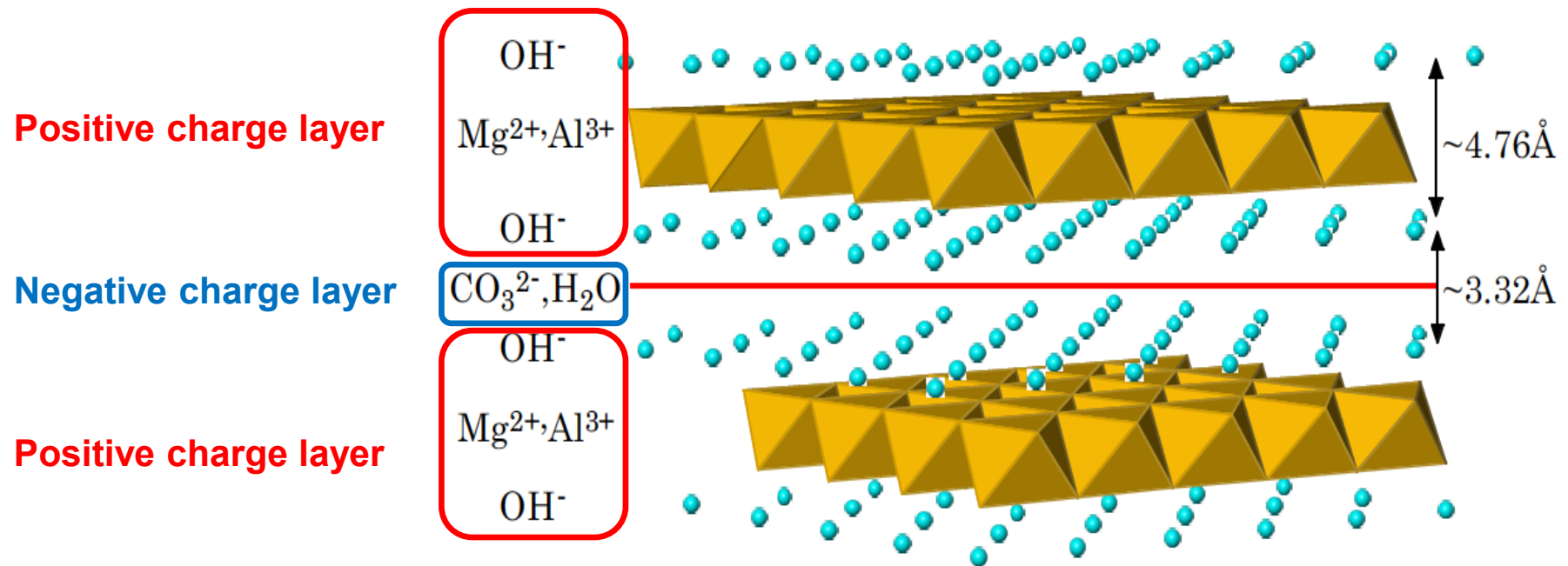
- Environmentally friendly lead-free materials for polyvinyl chloride stabilizers.
- Heat retaining agent for agricultural polyolefin film.
- Ion trap materials for semiconductor encapsulants.
- Anion adsorbent for water treatment.

Our long-cultivated wet synthesis technologies enable us to design the optimum particle shape and control the composition for various applications.



# Crystal structure of hydrotalcite

Typical composition :  $\text{Mg}_6\text{Al}_2(\text{OH})_{16}\text{CO}_3 \cdot 4\text{H}_2\text{O}$



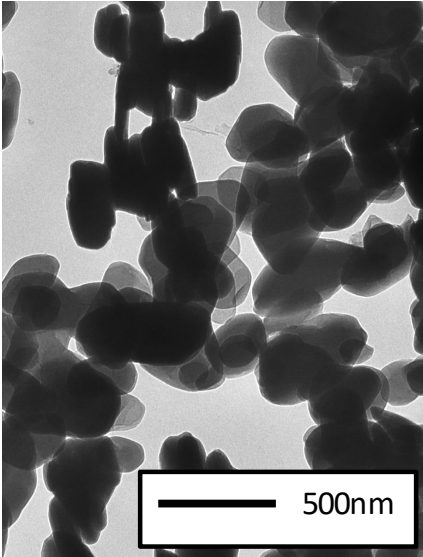
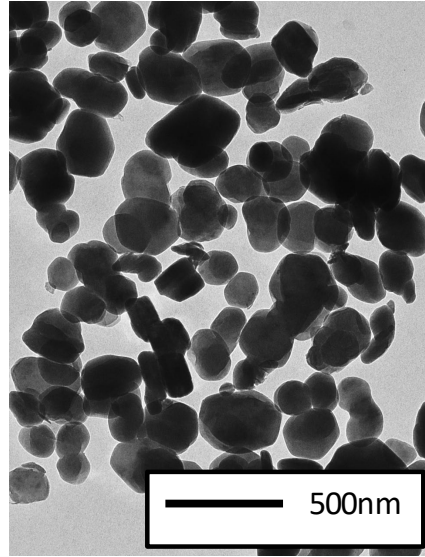
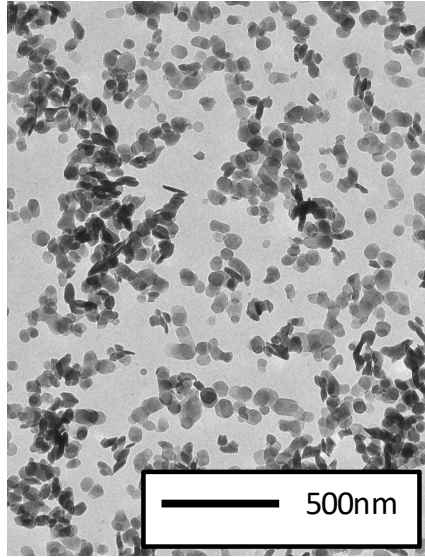
## Characteristic

- Exchangeable with various anions
- Variable Mg/Al ratio ( $1.5 \leq \text{Mg/Al} \leq 4.0$ )
- Dehydration by heating, porousization by decarboxylation

## Application

Adsorbent  
Catalyst carrier, etc.

# Hydrotalcite manufactured by TODA KOGYO

		Large particles	Middle particles	Small particles
Average particle size	nm	300	200	60
BET specific surface area	m <sup>2</sup> /g	12~14	13~15	40~45
Transmission electron microscope image				

**“Particle size control technology” + “Features of hydrotalcite”  
⇒ Expansion to various applications**

# Functions and applications of hydrotalcite

## I . Intercalation of various anions

- PVC stabilizer (non-toxic : lead substitute)
- Various anion absorbents



## II . Colorless additives by combination of colorless metals

- Heat retaining agent for agricultural PO film  
(Far infrared absorption capability + Transparency)
- Transparent resin additives (Acid acceptor, filler, etc.)



## III . Combination of various metals (divalent or trivalent)

- Immobilization of functional metals (Ni, Cu, Fe . . . )  
for catalyst applications



## IV . Reversible changes in hydroxide and oxide by heating/hydration

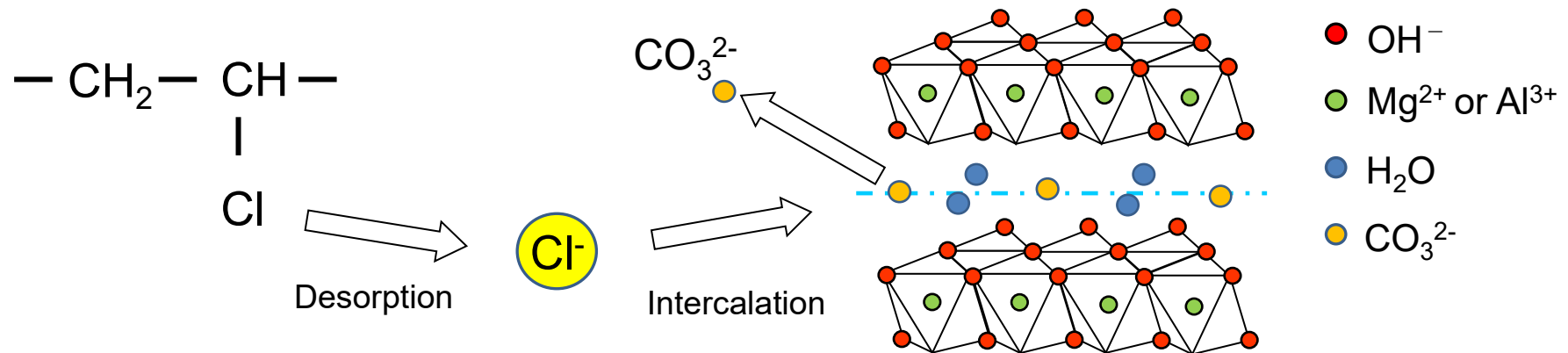
- Humidity controlled by moisture control, absolutely dry function

# I . Intercalation of various anions

## PVC stabilizer

It's used as the additive which improves durability for ultraviolet rays or heat.

**Hydrotalcite captures chlorine desorbed due to deterioration.**



Accelerated degradation test of vinyl chloride resin. \*Comparison of appearance change depending on heat time at 190°C

Heat time (min.)	0	20	40	60	80	100	120	140	160	180
Without hydrotalcite								—	—	—
<b>With hydrotalcite</b>										

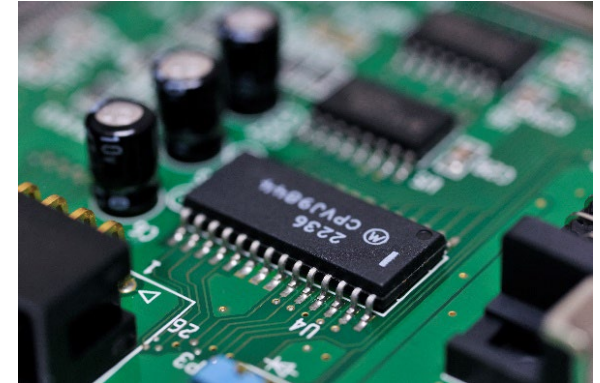
⇒ It can be seen that the deterioration is significantly suppressed by addition of hydrotalcite.

# I . Intercalation of various anions

## Chlorine capture for semiconductor encapsulants

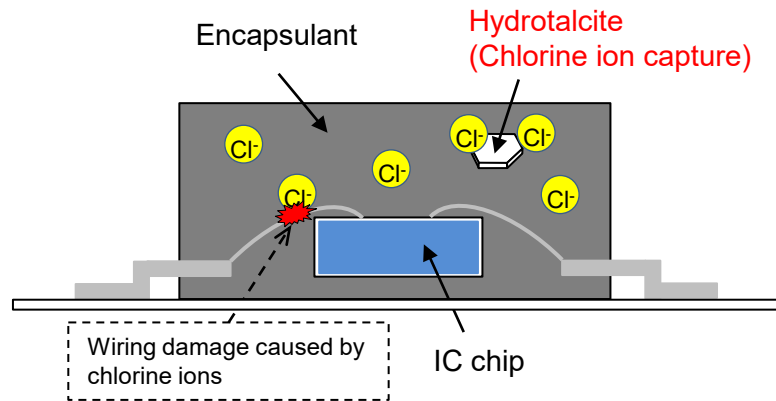
A semiconductor encapsulant is one of the materials that make up a semiconductor package to protect a semiconductor from light, heat, humidity, dust, and shock. It consists of resin materials such as epoxy and silicone, curing agents, fillers, and additives.

One of the additives is an anion adsorbent, and hydrotalcite is used as its material. Hydrotalcite captures chlorine ions contained in the resin material and prevents disconnection of the wiring circuit.

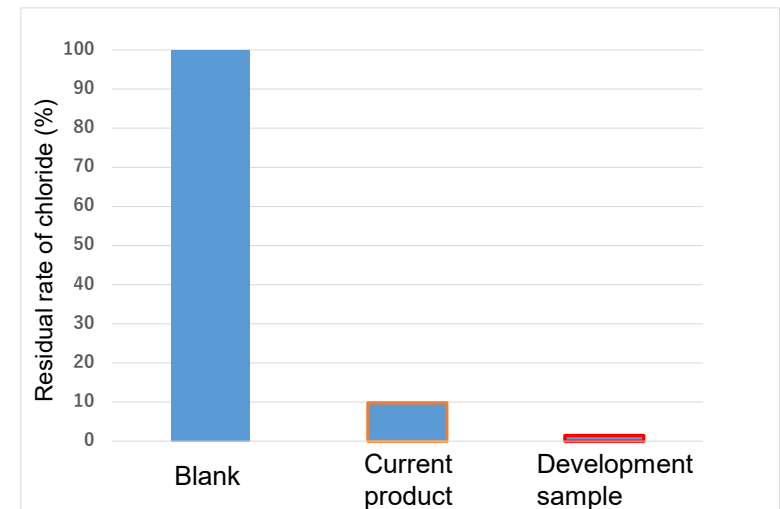


- **High chlorine capture ability.**
- **Fine particle design for fine wiring.**

### Semiconductor chip image



### Chlorine adsorption performance evaluation (Pressure Cooker Test)



\* Bisphenol epoxy resin + amine-based curing agent 100%, Hydrotalcite 2.0 %  
\* Pressure cooker test : sample/ion-exchanged water = 5.0g/50ml, 120°C \* 24hr

## II. Colorless additives by combination of colorless metals

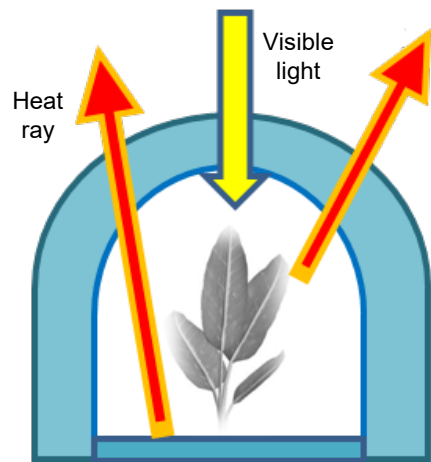
### Heat retaining agent for agricultural PO film

Hydrotalcite is used in agricultural polyolefin film as an additive that can impart high far infrared absorption capability without impairing transparency.

- **Refractive index control.**
- **High infrared absorption capability.**

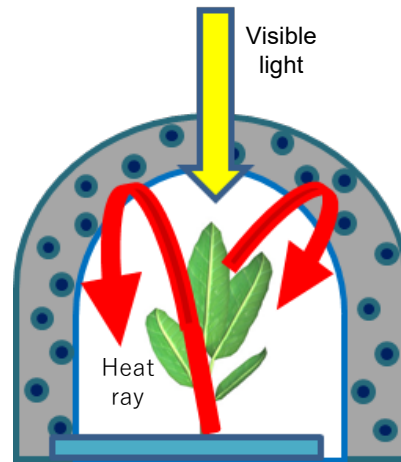
About  $1400\text{cm}^{-1}$  absorption band of hydrotalcite absorb heat ray radiation from the ground and plants.

(a) PO film without hydrotalcite

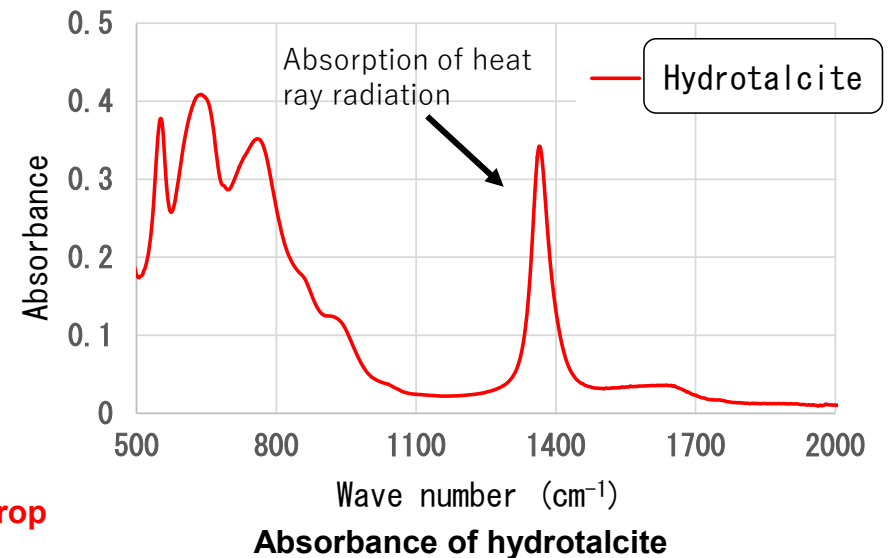


Transparent but no heat retention  
⇒ The temperature drops at night.

(b) PO film with hydrotalcite



Transparent and heat retaining  
⇒ The temperature does not drop even at night.





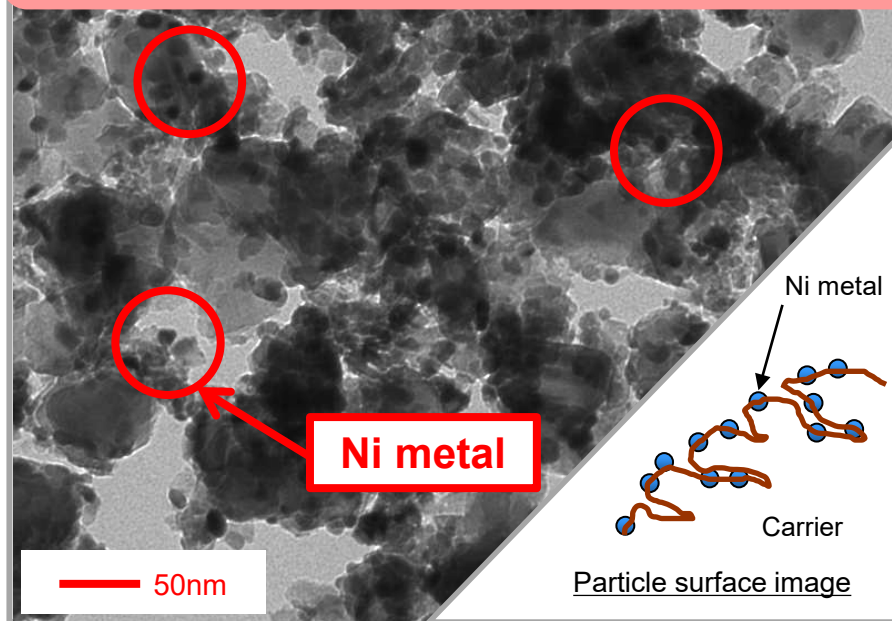
### III. Combination of various metals

#### Catalyst for steam reforming

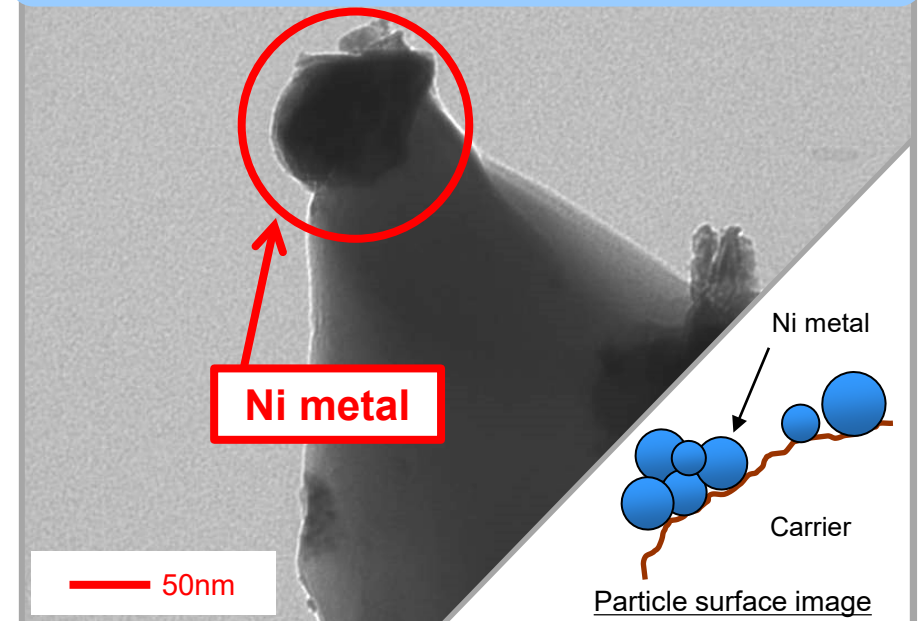
Hydrotalcite can immobilize various metals. Therefore, it is used as a carrier in catalyst applications. In steam reforming catalyst applications, it is possible to provide highly active and durable catalysts without using precious metals. The nano-Ni catalyst produced by our unique synthesis technologies make this possible.

- High dispersion with single nano size nickel.
- High catalytic activity.

**TODA KOGYO's Ni catalyst**  
(BET : 37.6 m<sup>2</sup>/g)



**General Ni catalyst**  
(BET : 2.8 m<sup>2</sup>/g)





**TODA KOGYO CORP.**

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