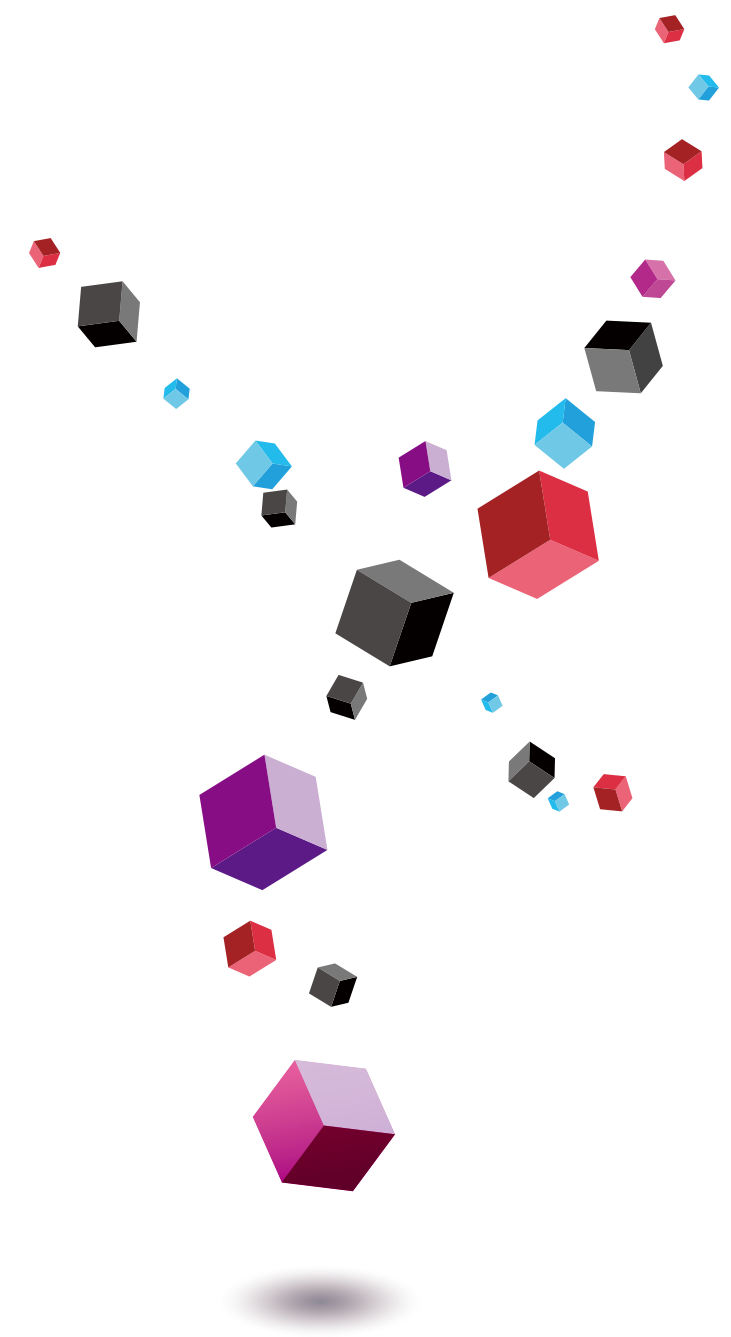
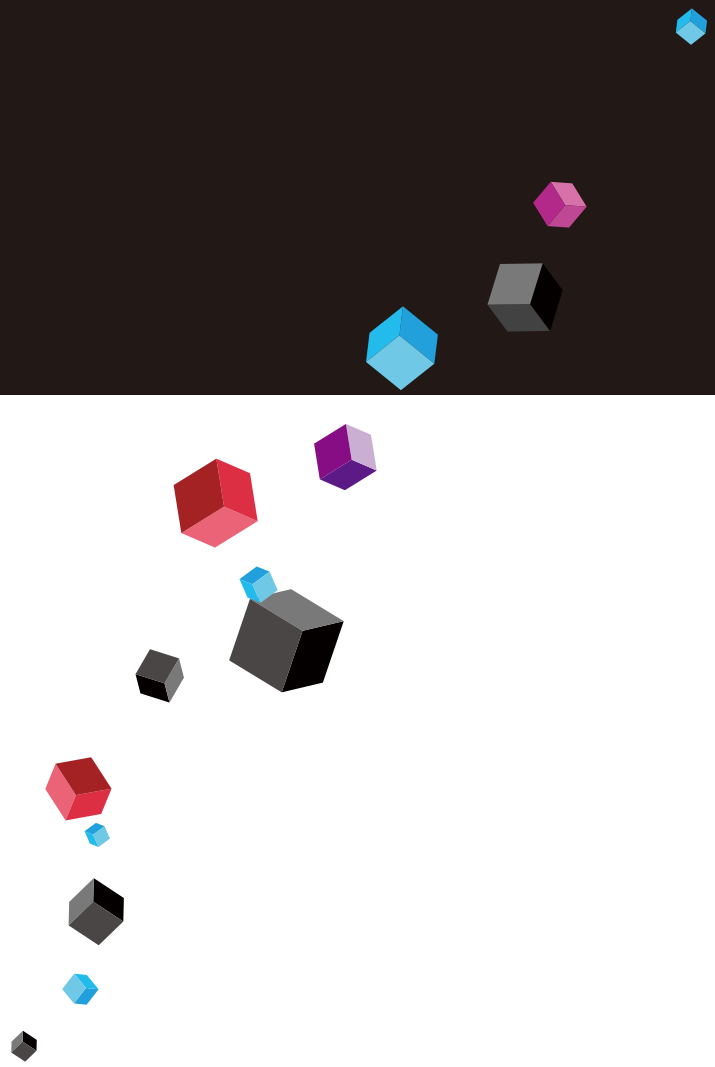


Nano-sized Zeolite
Zeoal[®]
Zeolite's Functions for New applications.



 **Nakamura Choukou Co.,Ltd.**
<http://www.nakamura-gp.co.jp>
593-8323 27-27 Tsurutacho, Nishi-ku, Sakai City, Osaka
☎ **072-274-0777**
zeolite-eigyo@nakamura-gp.co.jp
FAX: 072-273-3313

Nano-sized Zeolite Zeoal®

Zeoal® 4A

Hydrophilic

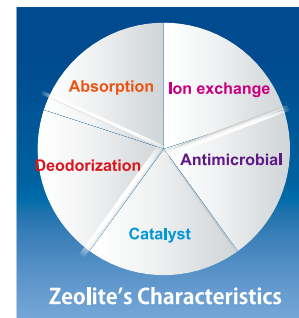
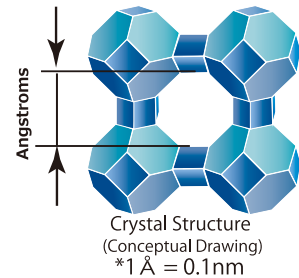
Zeolite's Functions for New applications.

What is Synthetic Zeolite?

Also referred to as zeolite, it is an aluminosilicate that has a nano space within its crystalline structure. The pore size is in Å (Angstroms). By utilizing the space within the structure and the pore size, it can function as an absorbent material and a molecular sieve.



Zeolite Particles (Example)



Nanoparticle Transformation Technology

Nakamura Choukou Co., Ltd. In collaboration with the University of Tokyo, developed an innovative production process for "Nano-sized Zeolite" by utilizing the milling and recrystallizing technology. The company succeeded in low-cost production. It is possible to retain the original ability like absorption and other functions while reducing its particle diameter as low as 50 nm.



Milling and Recrystallization

A Practical Application of Technology
Seeds from the University of Tokyo

Patent

Patent 6528615

(Toru Wakihara, Nakamura Choukou Co., Ltd.)



Benefits of Changing to Nanoparticles

Particle Diameter

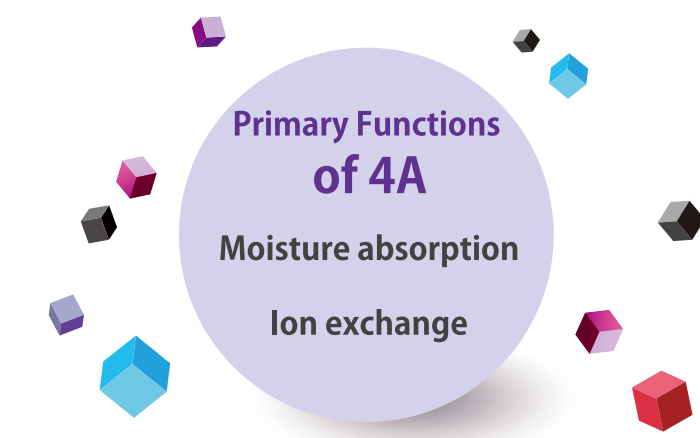
Microscopic 50 nm-

- Excellent for optical property
- Smooth texture
- Can be used in narrow spaces
- Good dispersibility

the Particle Count

Several Million Times

- Fast absorption speed
- High activity



Linde type A (A-type zeolite)

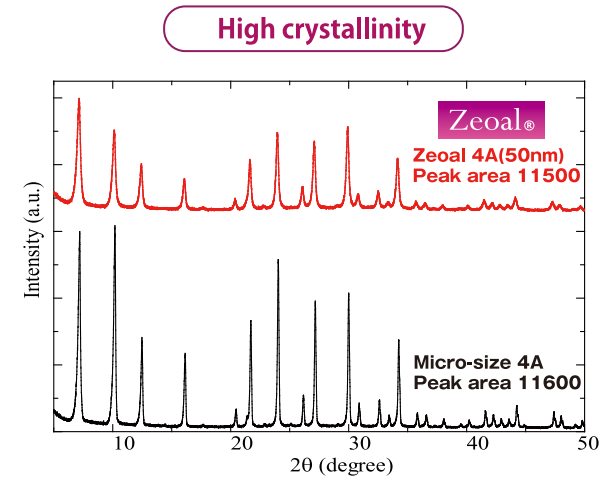
Structure code : LTA

Unit cell composition : {Na₁₂[Al₁₂Si₁₂O₄₈]·27H₂O}₈

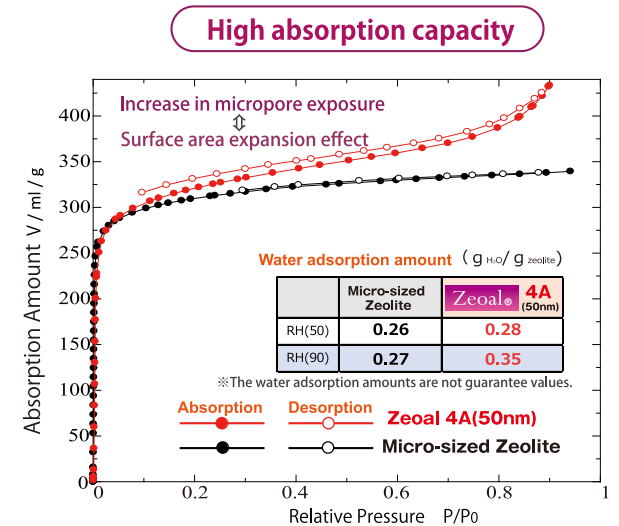
Pore size : 4 Å

Particle size : 50nm and more

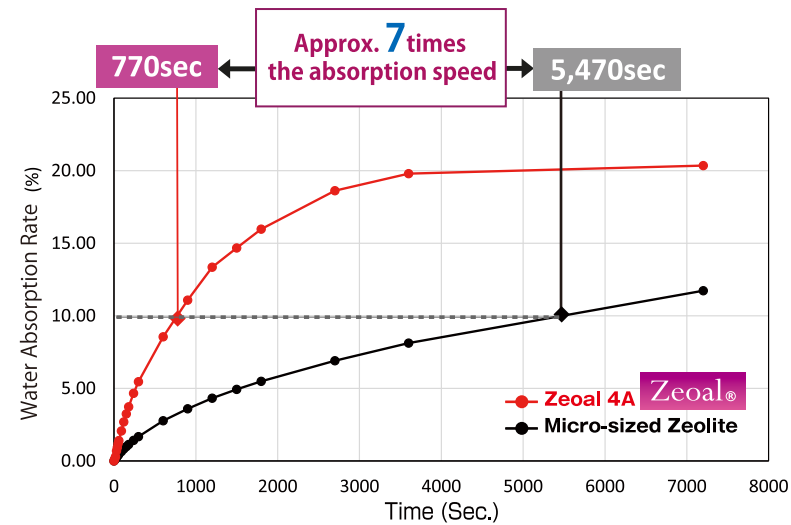
Crystalline XRD Pattern /A-type zeolite phase



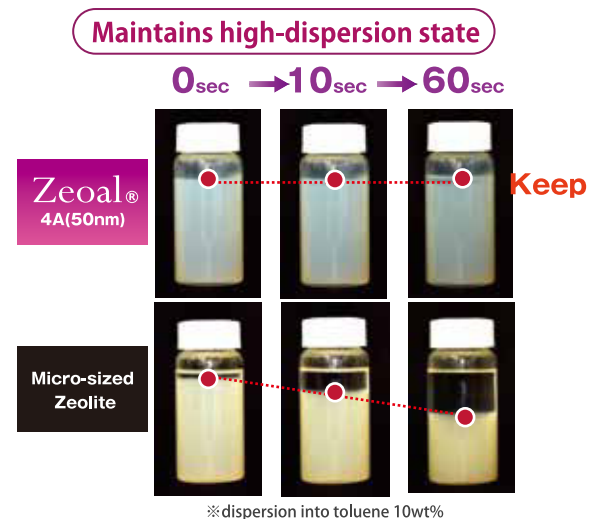
Steam Absorption/Desorption Isotherm



Moisture Absorption Speed



Dispersion Properties



Zeolal®

4A

Hydrophilic

Zeolal®

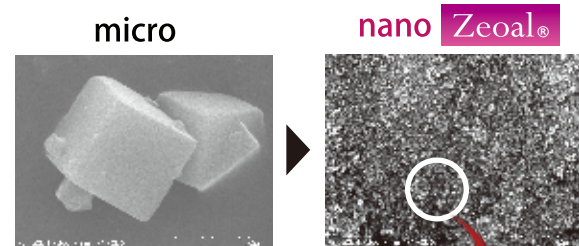
ZSM-5

Hydrophobic

Particle Size Controlled According to Use

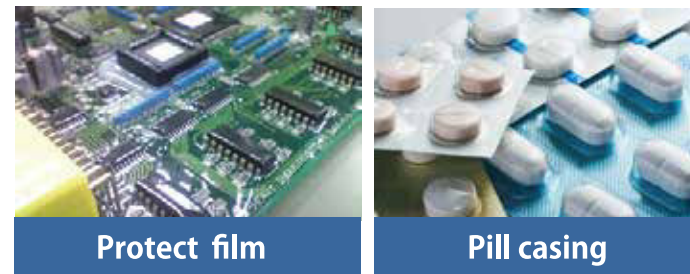
100nm under size

Size control that maximizes the effect of nanoparticles



Visibility (Transparency) + Ultrafast absorbing (barrier) capability (Humidity, carbon dioxide, etc.)

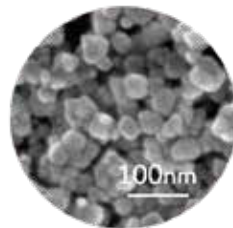
Example Application: Film kneading, as an additive to thin-film coating materials



Particle-size distribution (Reference)

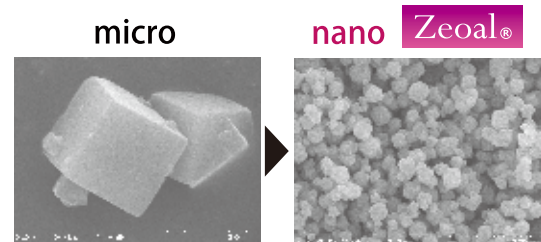
	Grain size (nm)
D10	24
D50	48
D90	89

*The particle size distribution is a number-size distribution. *Values not guaranteed.



100nm over size

Size control that avoids nano risk

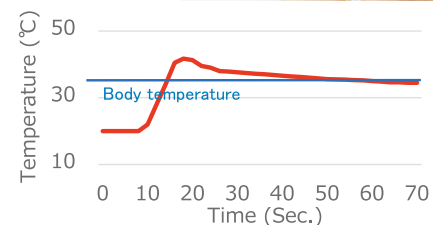


Particle-size distribution (Reference)

	Grain size (nm)
D1	136
D10	229
D50	375
D90	551

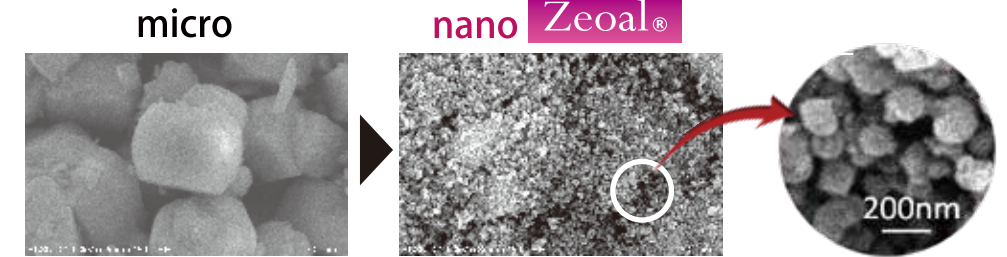
*The particle size distribution is a number-size distribution. *Values not guaranteed.

Example Application: Add to skincare products



Cleansing Treatment Shaving, etc.

Main Functions of ZSM-5 Catalyst VOC absorption



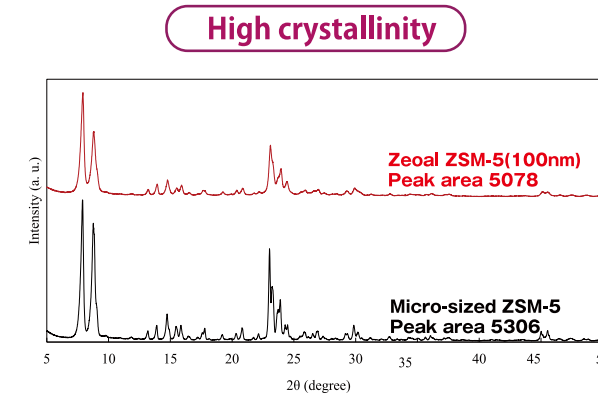
ZSM-5 type Zeolite Structure code:MFI Unit cell composition:Na_n[Al_nSi_{96-n}O₁₉₂]·xH₂O Pore size: ≈6Å Particle size: 100nm or larger SAR: 300&800

Particle-size distribution (Reference)

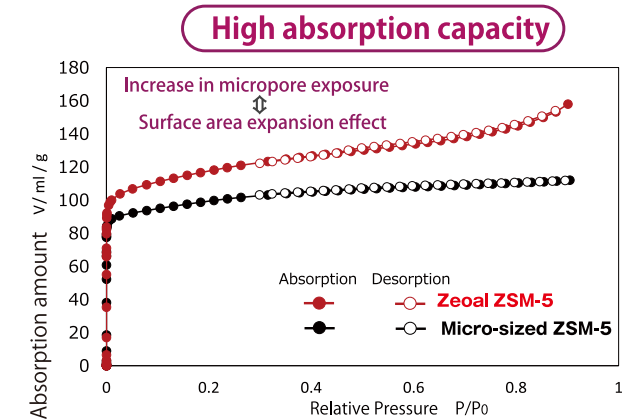
	Grain size (nm)
D10	77
D50	99
D90	121

*The particle size distribution is a number-size distribution. *Values not guaranteed.

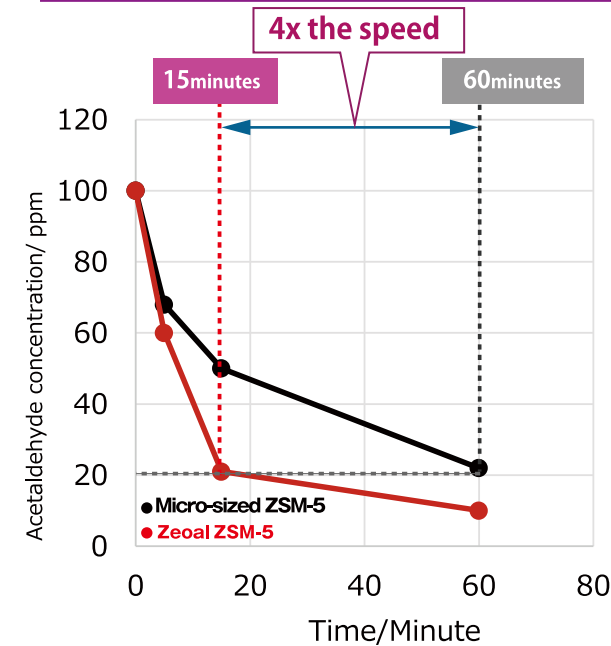
Crystalline XRD Pattern /MFI zeolite phase



Nitrogen Absorption/Desorption Isotherm



Absorption Speed



Example Application



Deodorization/Gas Absorption Film



VOC absorption filter

Masterbatch for Use in Films

A high-dispersion compound created using our unique kneading technology. The functions of nano-sized zeolite are easier to use than ever.



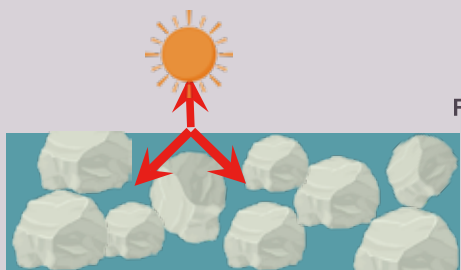
Can be used as a compound as well

Nano-sized Zeolite
Zeoal®
A high-dispersion compound - 30wt%

Polyolefin
PE PP + Nano-sized Zeolite
Zeoal®
Hydrophilic 4A 50nm
Hydrophobic ZSM-5 100nm

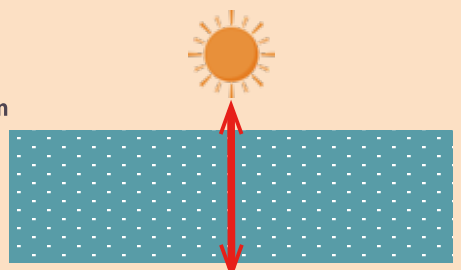


A cloudy white color



Micro-sized Zeolite

High Transparency



Zeoal®

Resin Film
4A 30wt% added
Film thickness: 0.15mm

Film Prototype Made from Masterbatch

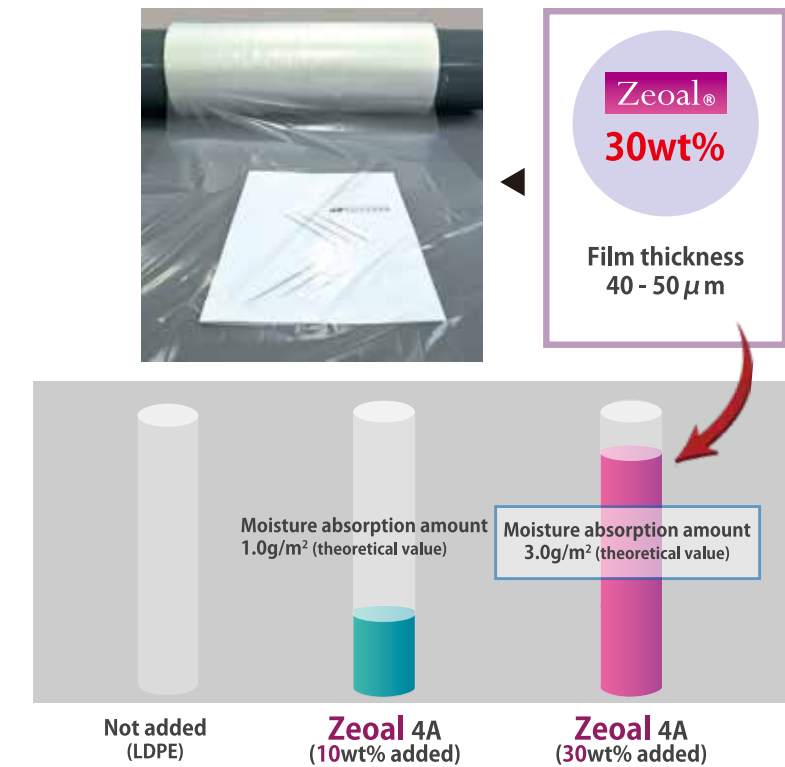
Prototype Example ①

LDPE + 4A (50nm)

MB Specification	
Base resin	LDPE
Amount of Zeol added	30wt%
MFR	4.5

Film Evaluation	
Zeol Content	Haze
None	31.2
10 wt%	39.1
30 wt%	~30 *

* Reference values from the developed product. (Some specifications are different.)

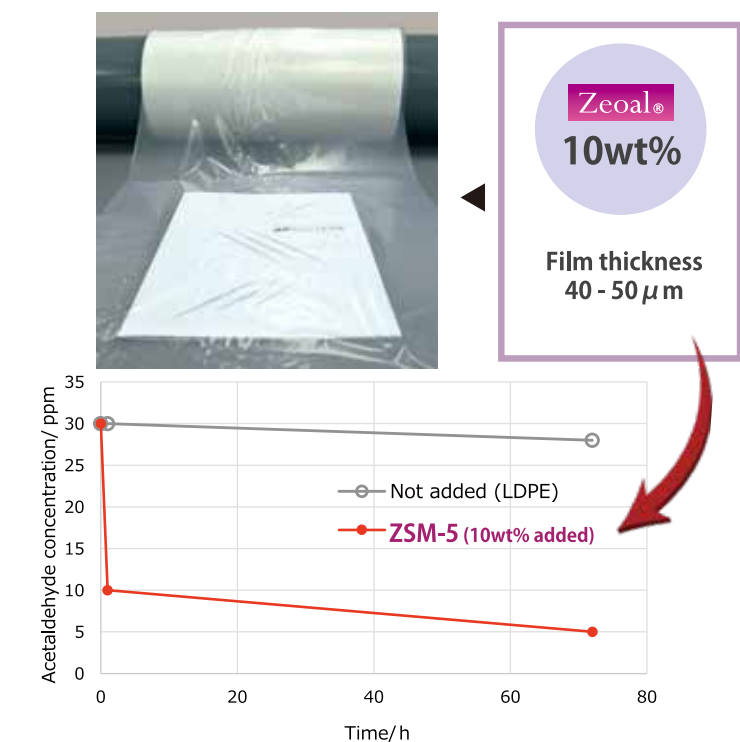


Prototype Example ②

LDPE + ZSM-5 (100nm)

MB Specification	
Base resin	LDPE
Amount of Zeol added	30wt%
MFR	2.0

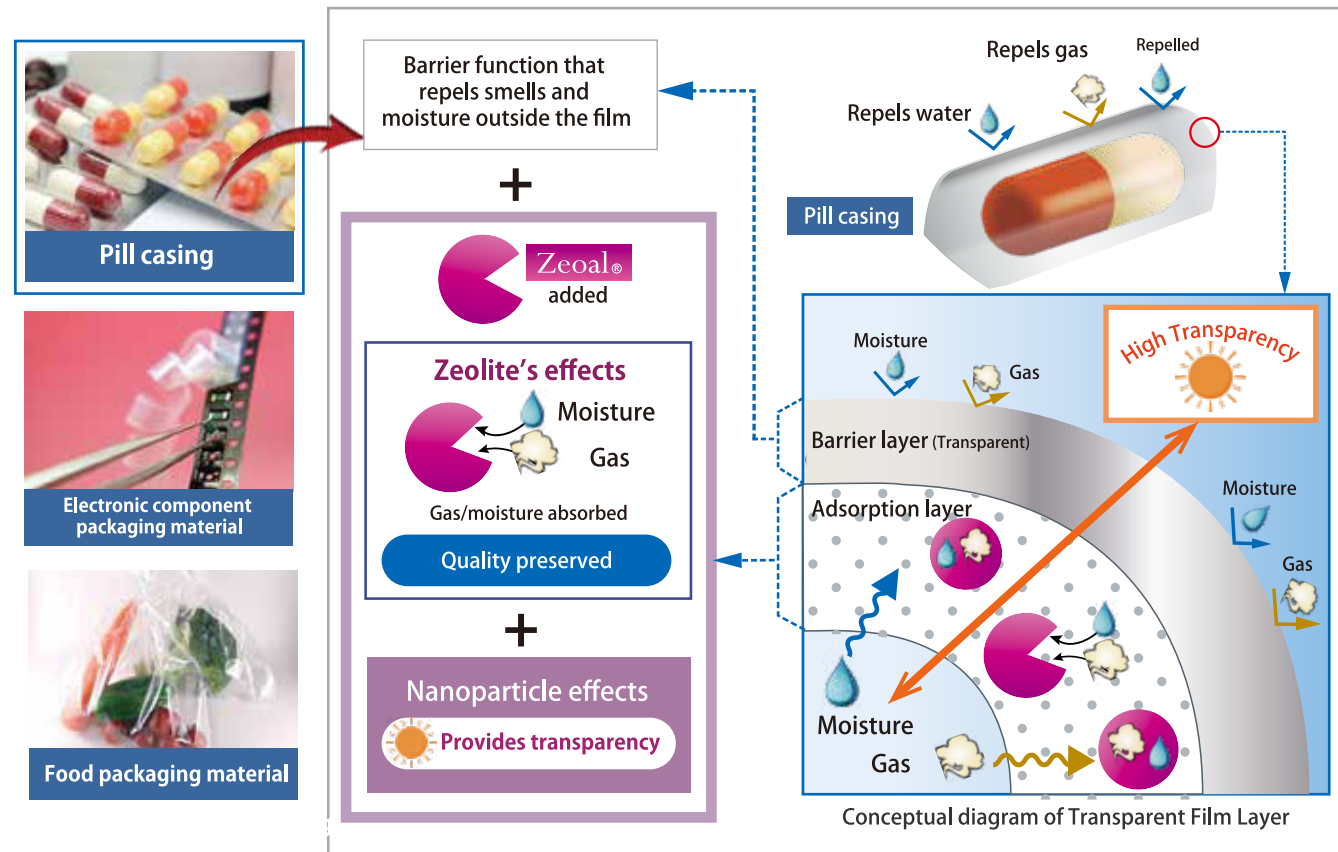
Film Evaluation	
Zeol Content	Haze
None	29.9
10 wt%	30.6



Examples of Nano-sized Zeolite Applications

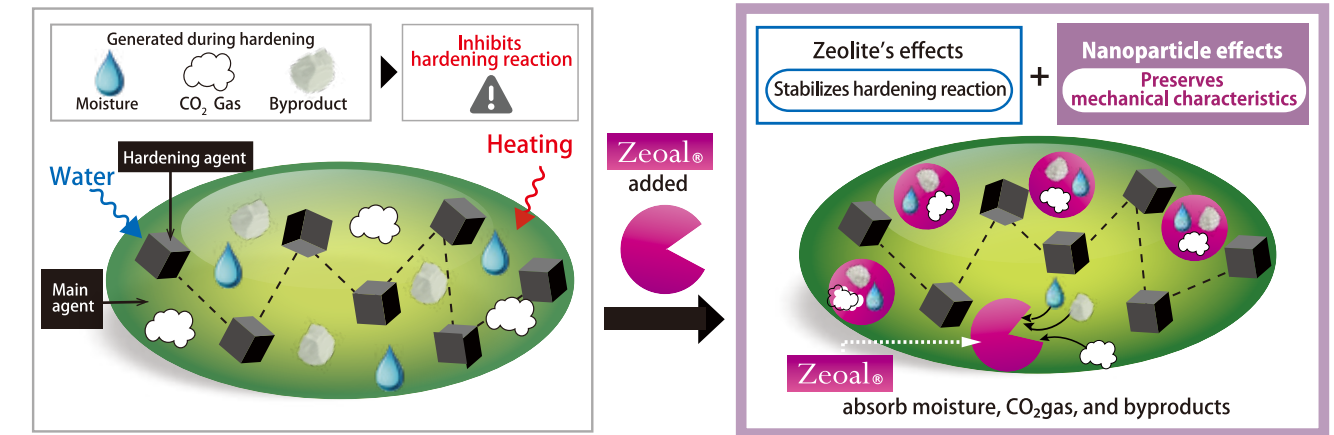
Example Application 1 Transparent/absorbent film

Barrier function + Absorption and Visibility function



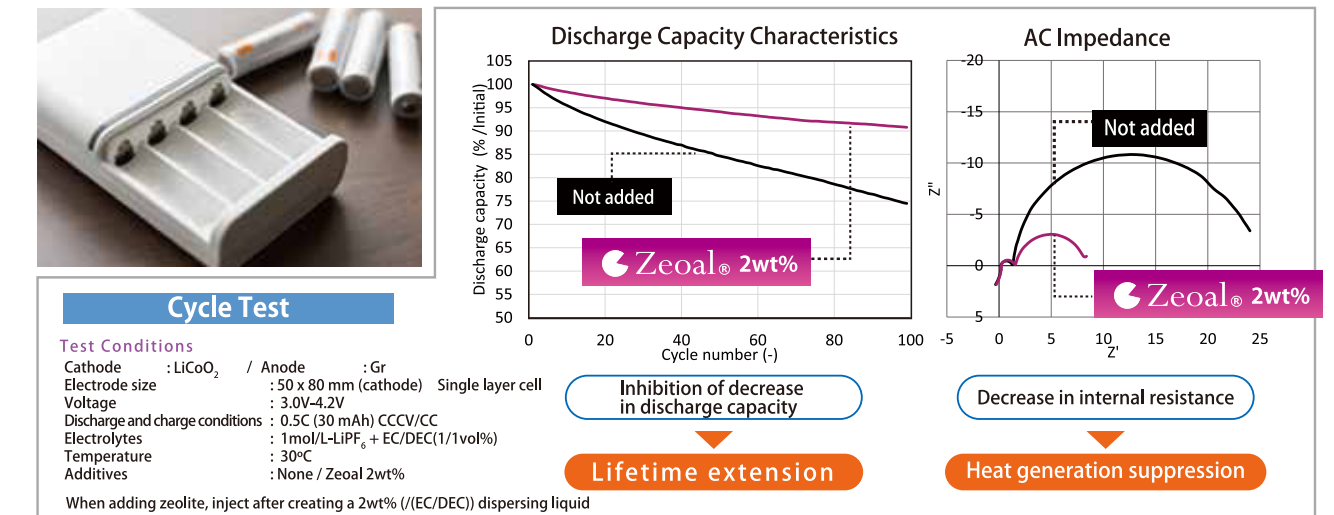
Example Application 3 Two-part adhesive

Improves stability of adhesive quality



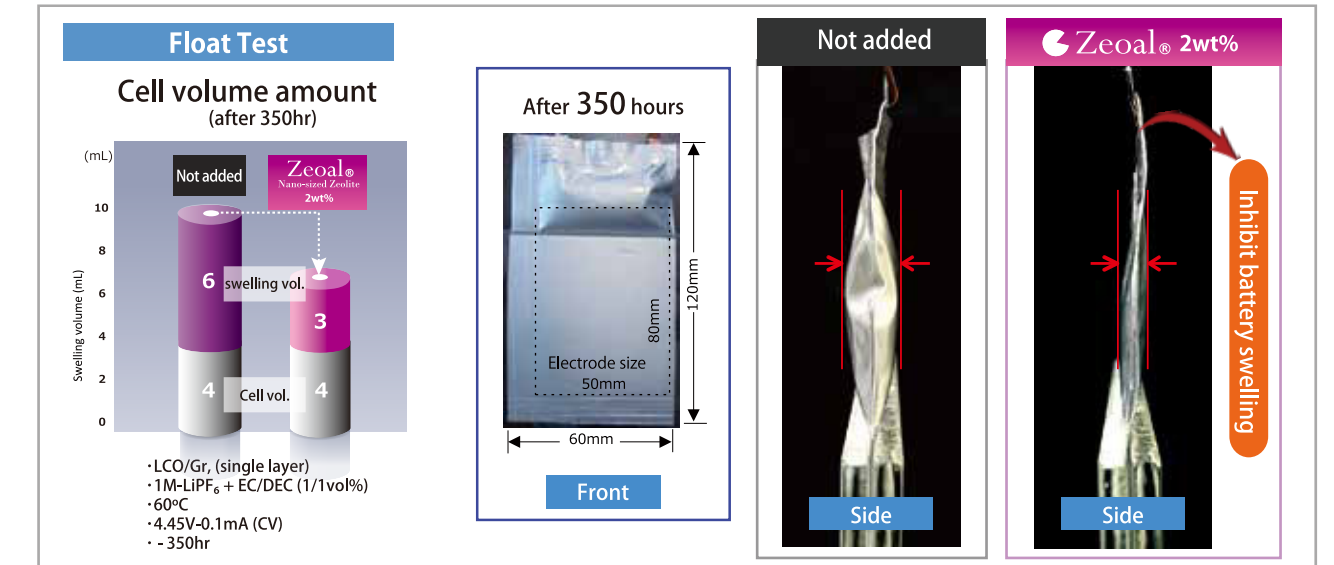
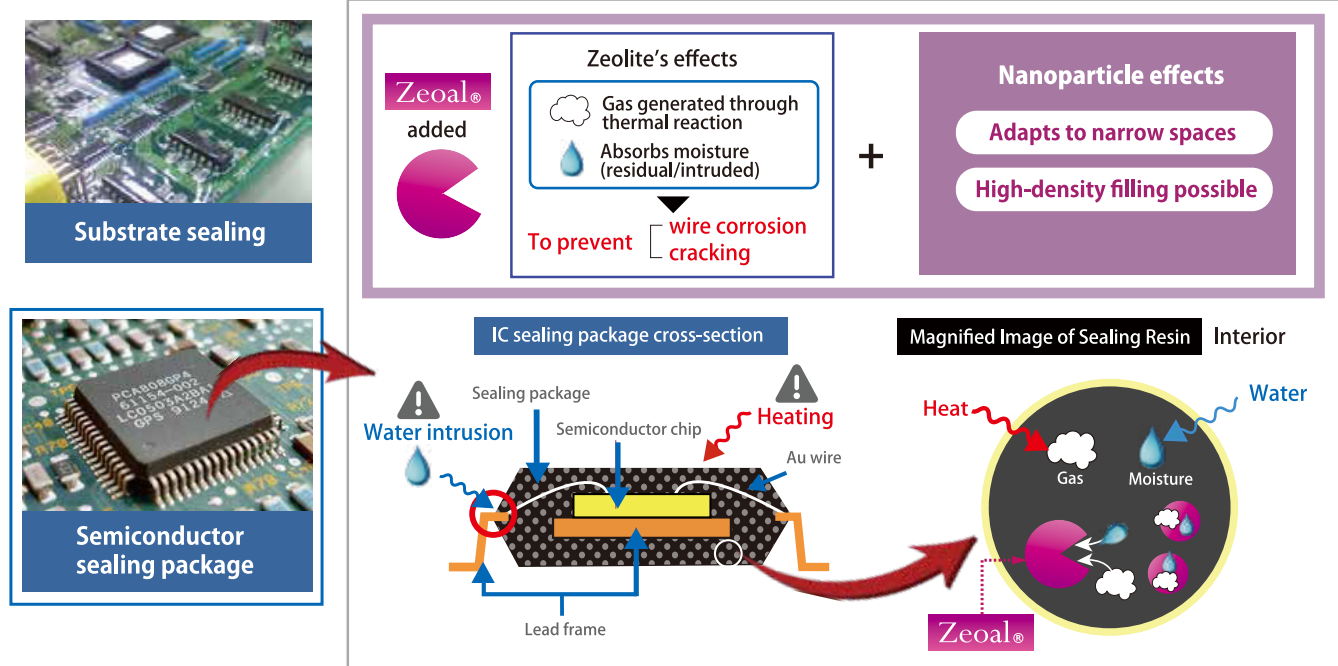
Example Application 4 Lithium Ion Battery

High dispersibility allows for high performance using small amounts; can be added to narrow spaces



Example Application 2 Sealing material

Improved reliability of sealing function



Product Form List

Company Overview · Office Location



4A	50nm
4A	300nm
ZSM-5	100nm

*The actual particle size may differ from the nominal value (D50).



4A	50nm	30 wt% × PE
		24 wt% × PP



ZSM-5	100nm	30 wt% × PE
		24 wt% × PP



4A	50nm	45 wt% × Polyolefin (low molecular weight)
----	------	---

ZSM-5	100nm	45 wt% × Polyolefin (low molecular weight)
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4A	50nm	10 - 30 wt% × solvent (Water, Toluene, MEK, other)
ZSM-5	100nm	

Company Outline

Headquarters Location 27-27 Tsurutacho, Nishi-ku, Sakai City, Osaka

Date Founded December 21, 1970

Representative President Makoto Inoue

Business Content

- Development, manufacture, and distribution of diamond saw wire
- Development, manufacture, and distribution of special high-precision parts and tools
- Design, manufacture, and distribution of spinning nozzles for chemical fibers and peripheral parts



High-precision Equipment Business
Material Science Business **Zeol**

Headquarters (MAC Center)



27-27 Tsurutacho, Nishi-ku, Sakai City, Osaka 593-8323

Management Division 072-274-0007 / FAX: 072-273-1250

High-precision Equipment Business/Material Science Business **Zeol**
072-274-0777 / FAX: 072-273-3313

Izumi Factory

Electronic Material Slice Periphery Business



2-1-3 Ayumino, Izumi City, Osaka-fu 594-1157

0725-53-2525 / FAX: 0725-53-3333

Nippon Nozzle (Subsidiary)

Chemical Fiber Spinning Nozzle Business



2-1-1 Murotani, Nishi-ku, Kobe City 651-2241
(In Kobe High-Tech Park)

078-991-6821 (Sales Representative) / FAX: 078-991-6833