Scale-like powder made from dry & wet coating technologies

LeafPowder™ Introduction

Powder Material Strategic Business Unit
OIKE & Co., Ltd.

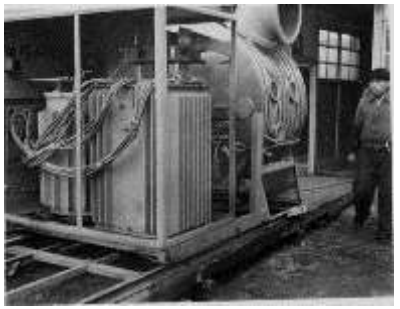
Oct.2020

What's OIKE?

144 years

OIKE & Co., Ltd. was founded in Kyoto in 1876 as a manufacturer and seller of gold and silver thread.

Wet & dry coating technology



The 1st vacuum vapor deposition apparatus

In 1956, OIKE first introduced Roll to Roll vacuum deposition system in Japan.

OIKE Core Technologies

Sub-technology & 2ndary fabrication technology

Strong adhesion process

Transfer film process

Slittering process

Physical Vapor Deposition

Sputtering

Patterining process

Peal-off process

OIKE Core technologies

Molding film process

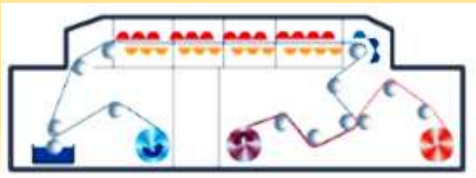
Powdering process

Adhesion process

Compound coating

Wet Coating

Lamination process



Surface analysis

Surface modification

Introduction of LeafPowder™

LeafPowder® Characteristics

Shape

Scale-like flake

- ✓ High aspect ratio
- ✓ Specific surface
- ✓ Flat and parallel

Dry coating

VD* & sputtering

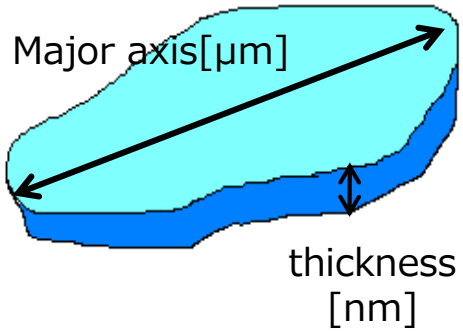
- ✓ Lamination
- ✓ Designed thickness
- ✓ Crystalline/amorphous

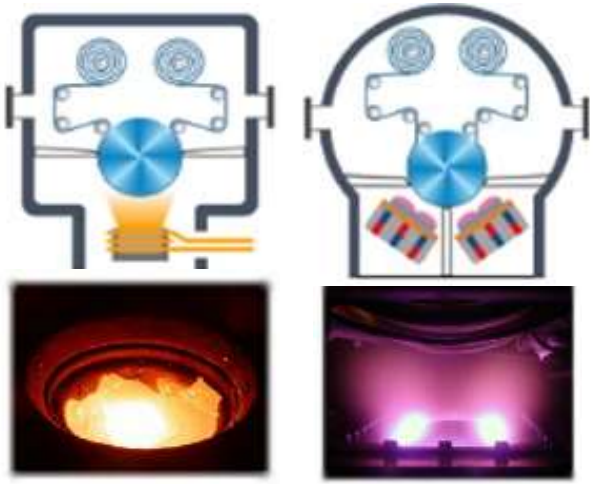
VD*:vapor deposition

Materials

Functional design

- ✓ Single metal
- ✓ Alloy
- ✓ Compounds

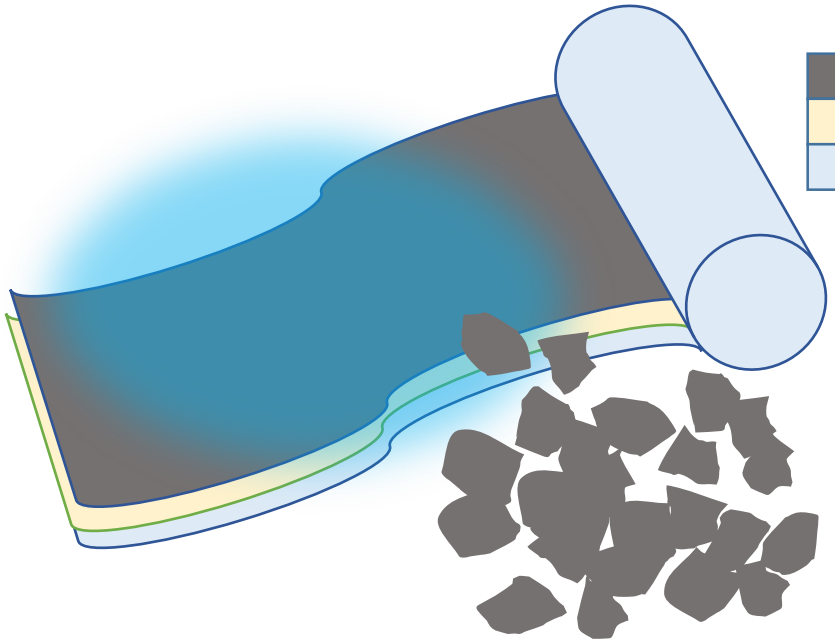




LeafPowder™

We produce **“LeafPowder™”** which is **scale-like flake** made from deposited layer by our **dry and wet coating technologies**.

1. Deposition on film → 2. Peeling with solvent → 3. Pulverization → 4. Dispersion



LeafPowder™

For metallic design

- LeafPowder™ Al
  scale-like Aluminum pigment for coating and printing to achieve metallic gloss and high specularity

Grade	thickness	contents	Ave. particle size	Dispersion solvent
Ultra high grade	10nm	10wt%	10μm 1μm	Butyl acetate (standard) N-propyl acetate PGM PGMA Butyl Cellosolve MMB, etc.
High grade	20nm			
Standard	40nm			

For metallic design

- LeafPowder™ In

  scale-like Indium pigment for water-based inks & coatings to achieve metallic gloss and high specularity

■ Preservation stability test

➢ Testing conditions

Sample: LeafPowder dispersion (solid contents 2.5wt%, IPA* : water = 1 : 1)
put in sealed vessel, measure inside pressure after 60℃×1month. *IPA=isopropyl alcohol

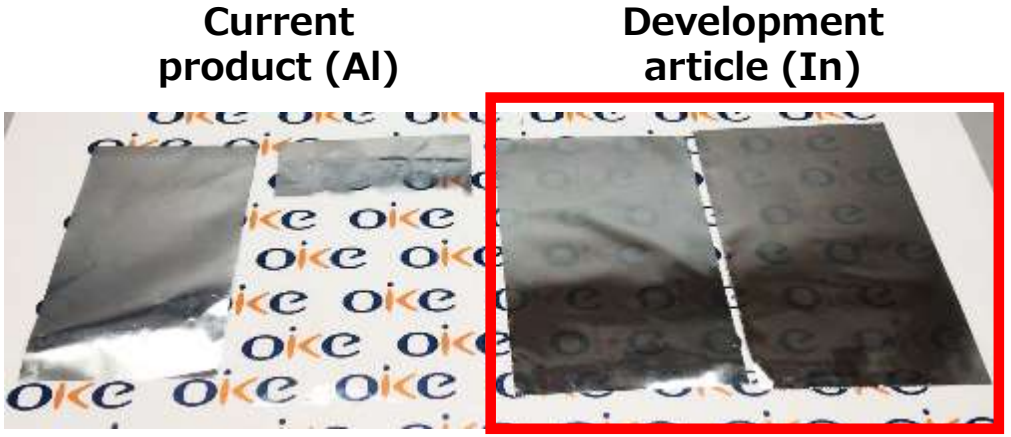
Metal species	Inside pressure (60℃×1month)	appearance
In	**Less than 0.2 kPa**	**No change**
Al	Over 20 kPa	Chlorosis, gelation

Grade	content	Ave. particle size	Dispersion solvent
49CJ - 1120	20wt%	～1μm	PGM CAS No.107-98-2

LeafPowder™ Indium
(correspond to solvent, UV and water-based ink)

Overwhelming water resistant ability

Bar-coated sample of water-based ink



60℃ water ×1month stability test result
(deposited film)

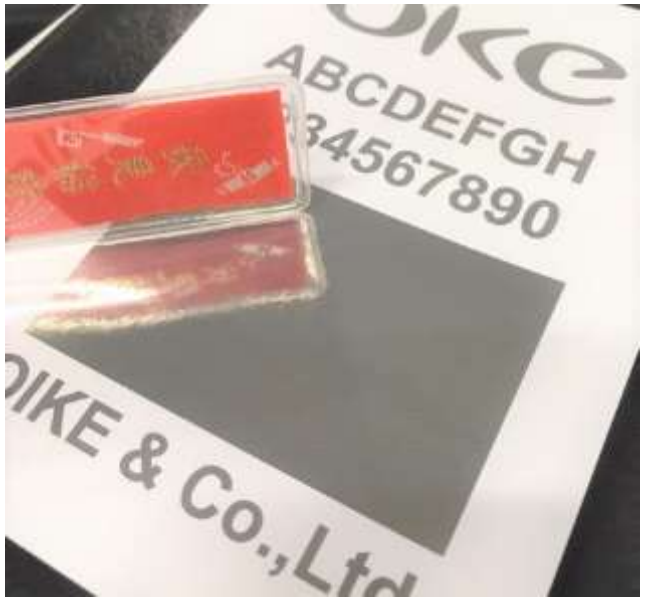
Achieve overwhelming water resistant ability by OIKE film converting technologies

All other values are either nominal values or typical (typ.) values, and are not guaranteed

LeafPowder™ Indium
(correspond to solvent, UV and water-based ink)

- **Specification**

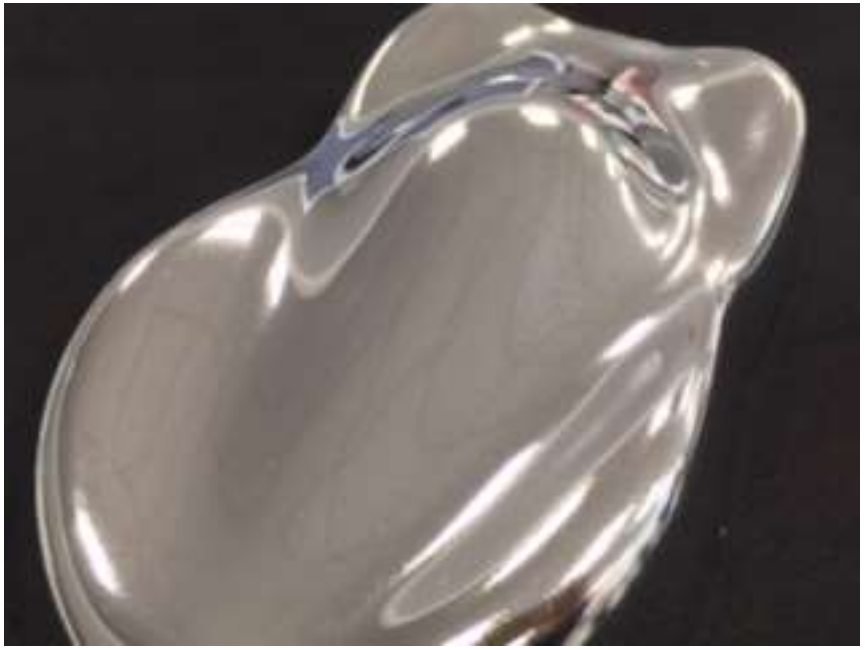
Grade	Solid contents	Particle size	Dispersant
49CJ-1120	20 wt%	～1μm	PGM CAS No.107-98-2



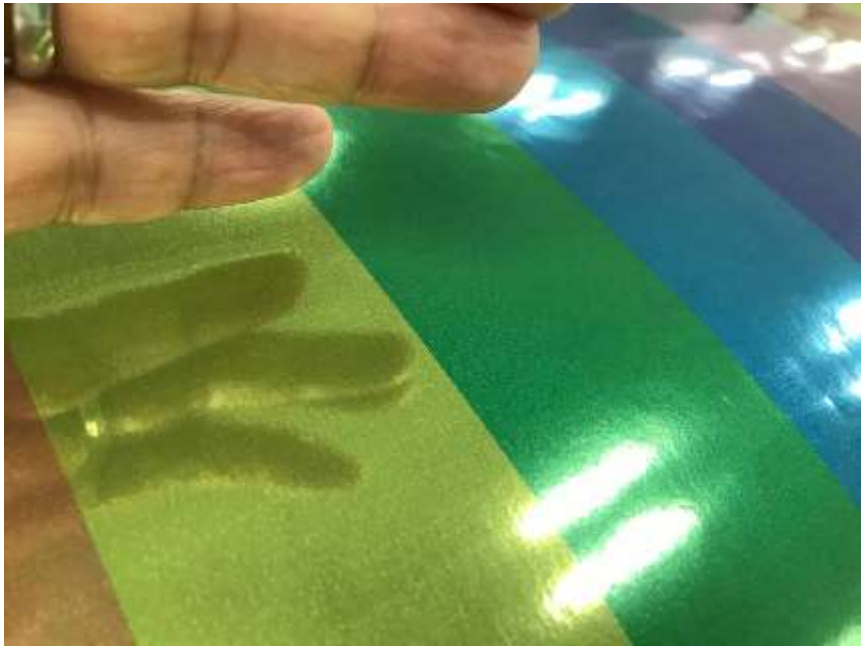
Inkjet printed sample of LeafPowder® In ink


Bar-coated sample of UV curing ink

Examples of LeafPowder™ Indium



Mirror coating sample of LeafPowder™ In



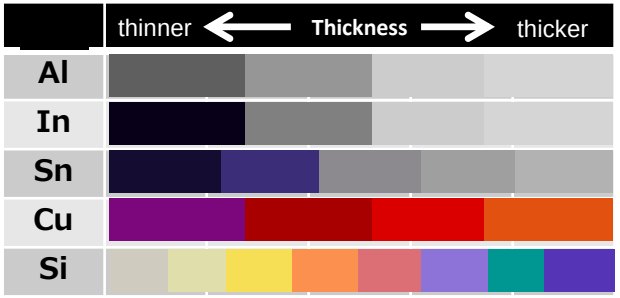
Color variations of LeafPowder™ In by solvent IJ ink

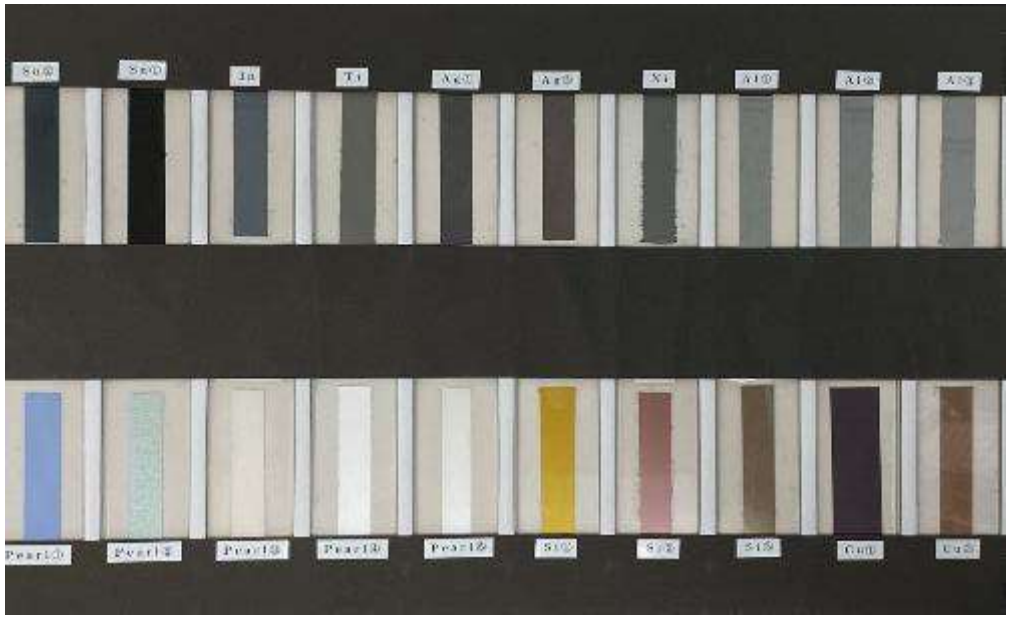
All other values are either nominal values or typical (typ.) values, and are not guaranteed

For color design

- LeafPowder™ various metal & compound
  Based on dry & wet coating technologies,

In・Sn … sharpness & cool metallic
Cu・Si … various colors depend on thickness



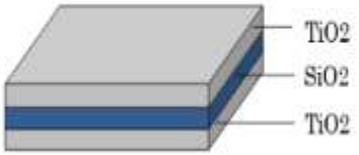


For pearl color design

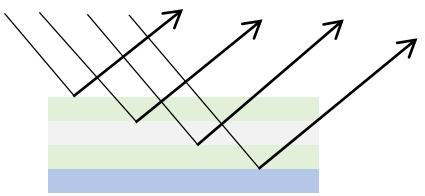
- LeafPowder™ TST (prototype)
  Based on vacuum deposition & sputtering technologies,

To achieve
✓ Various interference colors by laminated layers
✓ Silky & seamless reflection colors

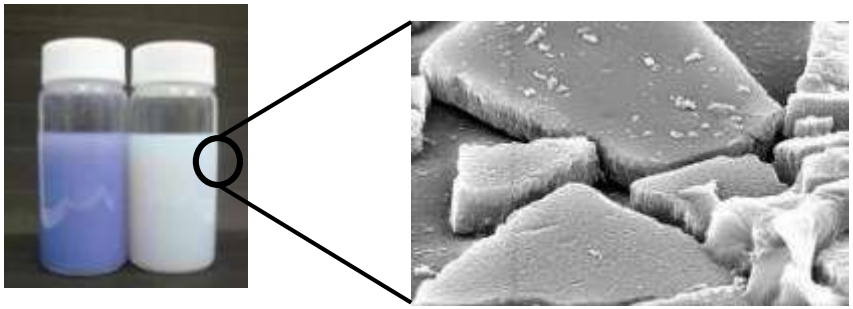
Cross section of pearl powder

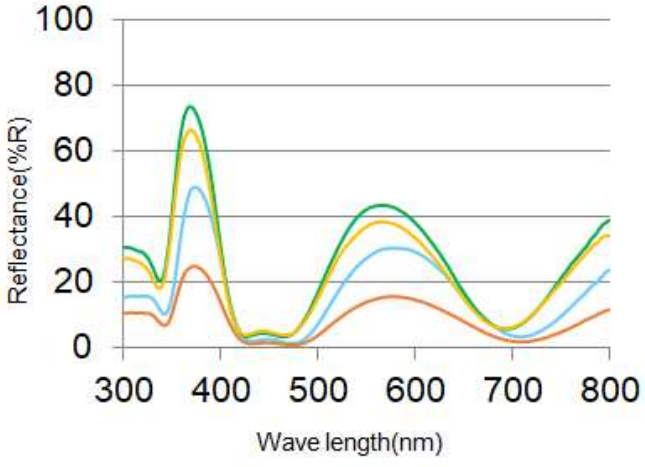


Structuring color principle



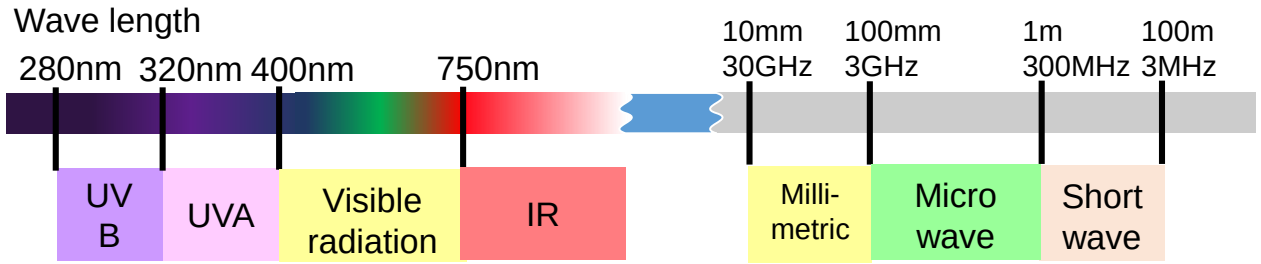
Interference colors by multiple reflections





For control of electromagnetic wave

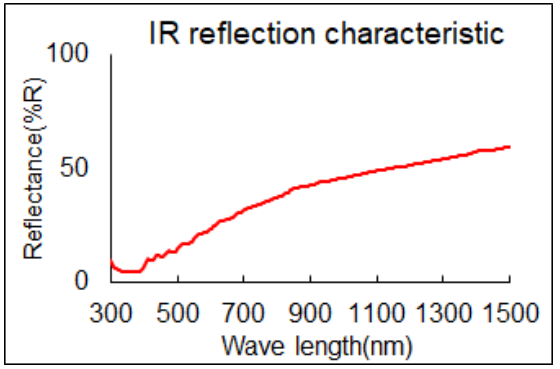
- Electromagnetic wave control
  To control transmission & reflections for several wavelength
  by optical simulations



- LeafPowder™ TiO_2 (prototype)

  To achieve UV shielding
  ✓Cosmetic (foundation, sun-screen powder, etc.)
  ✓Thinning out with comfortable & easy sliding feelings

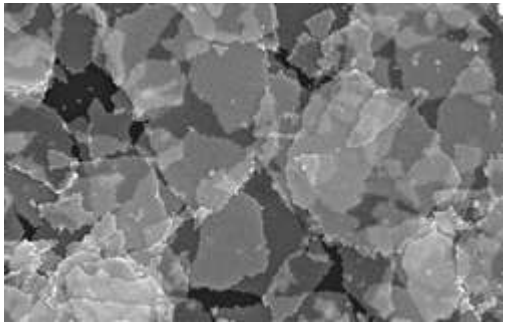
- LeafPowder™ SP1-01 (prototype)
  To achieve IR reflection
  ✓Anti-heat, correspond to LiDAR
  ✓Functional expression with low addition



Electromagnetic wave control

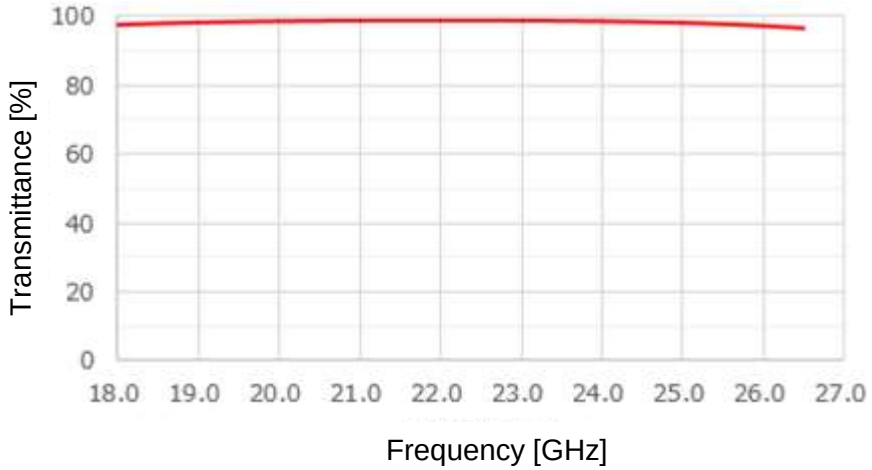
- LeafPowder™ EWC04 (prototype)

Grade	Solid contents	Particle size	Dispersant
EWC-04	10 wt%	10μm	Butyl acetate CAS No.123-86-4

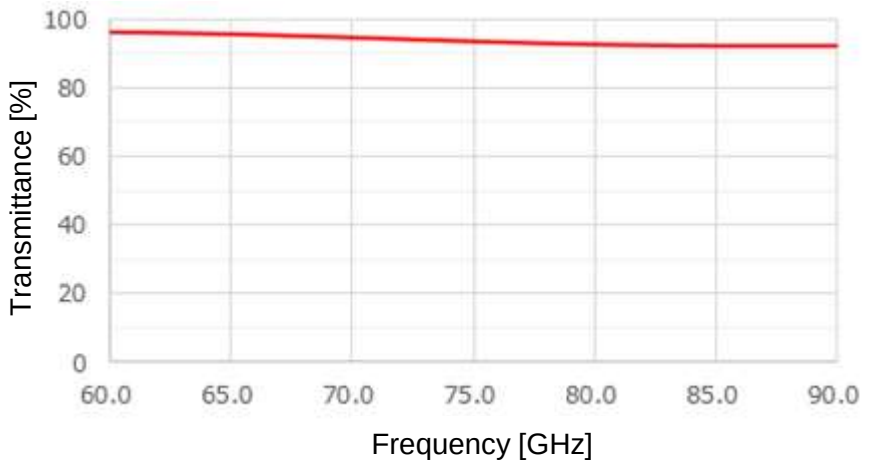


SEM image of LeafPowder™ EWC-04

Narrow band wave transmittance



Millimeter wave transmittance



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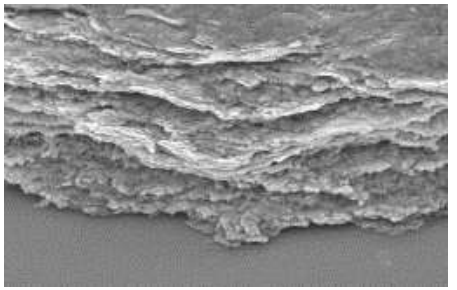
For electric conductivity

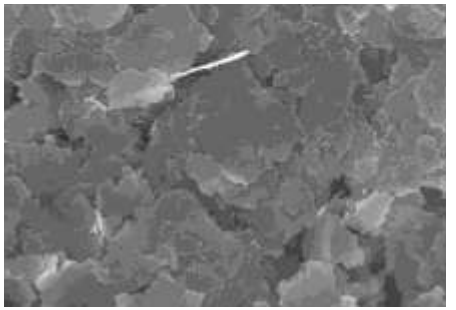
- LeafPowder™ Ag
  Nano & micron size powder
  ✓High aspect scale-like shape → thinner & high adhesion
  ✓To form flexible micro-wiring

Grade	content	Ave. particle size	Dispersion solvent
47CE - 2055	55wt%	3μm	Terpineol
47CE - 5060	60wt%	3μm	Butyl acetate



Cross section SEM of LeafPowder Ag

- LeafPowder™ Ni (prototype)
  Nano & micron size powder
  ✓For MLCC internal electrodes
  ✓Thinner & high continuity



Cross section SEM of LeafPowder Ni

Others

- LeafPowder™ Si
  - ✓For evaluation as LIB anode material

Grade	Contents	Ave. particle size	Dispersion solvent
14AJJ - 5010	10wt%	4μm	Butyl acetate

- LeafPowder™ Cr (prototype)
  - ✓For metallic pigment

Grade	Contents	Ave. particle size	Dispersion solvent
24CJ - 5010	10wt%	～1μm	Butyl acetate

- LeafPowder™ CuSn (prototype)
  - ✓For antibacterial pigment

Grade	Contents	Ave. particle size	Dispersion solvent
SP3-01	10wt%	1μm	Butyl acetate

All other values are either nominal values or typical (typ.) values, and are not guaranteed

Antibacterial LeafPowder

- LeafPowder™ CuSn
  high aspect ratio scale-like powder to achieve both metallic image and antibacterial function

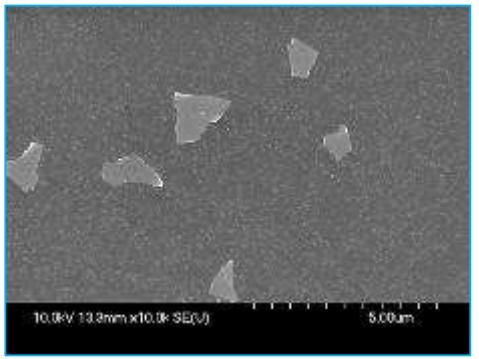
◆ Result

CuSn	Number of bacteria over time				
	initial	24hrs 1	24hrs 2	24hrs 3	Ave.
E.coli	2.3×10^5	<10	<10	<10	<10
St.aureus	2.2×10^5	<10	<10	<10	<10

Control

control	Number of bacteria over time				
	initial	24hrs-1	24hrs-2	24hrs-3	Ave.
E.coli	2.3×10^5	1.2×10^8	1.5×10^8	1.4×10^8	1.4×10^8
St.aureus	2.2×10^5	1.3×10^6	1.5×10^6	1.9×10^6	1.6×10^6

* <10 : not detected　　unit : CFU/Sample



SEM image of LeafPowder™ CuSn

✓As additive for antibacterial function

CuSn ink (solvent : binder : CuSn = 60 : 40 : 1)　(JIS Z 2801)

Bacteria	Number of bacteria over time					
	Sample	initial	24hrs-1	24hrs-2	24hrs-3	Ave.
E.coli	**CuSn ink**	**1.0×10^5**	**7.3×10^6**	**5.1×10^6**	**7.9×10^6**	**6.8×10^6**
	Control	1.0×10^5	1.4×10^7	1.2×10^7	1.6×10^7	1.4×10^7
St.aureus	**CuSn ink**	**1.1×10^5**	**8.8×10^2**	**1.0×10^3**	**1.0×10^3**	**9.6×10^2**
	Control	1.1×10^5	1.4×10^5	1.7×10^5	1.8×10^5	1.6×10^5

Reduce bacterial growth by low concentration !