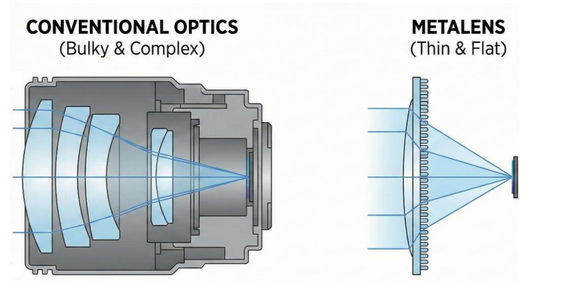
Plasma Etching Resistant UV Nanoimprint Materials

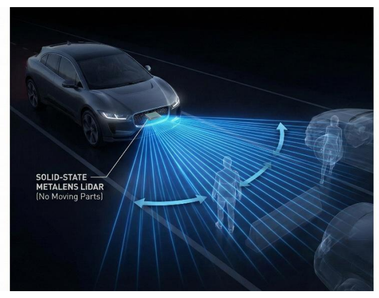
■ Product Overview

- **Nano-scale Precision:** Achieves high-fidelity imprinting at the nanometer order
- **Excellent Adhesion:** Enables primer-less adhesion to inorganic substrates such as glass and silicon wafers
- **Superior Etching Resistance:** Offers higher resistance compared to glass

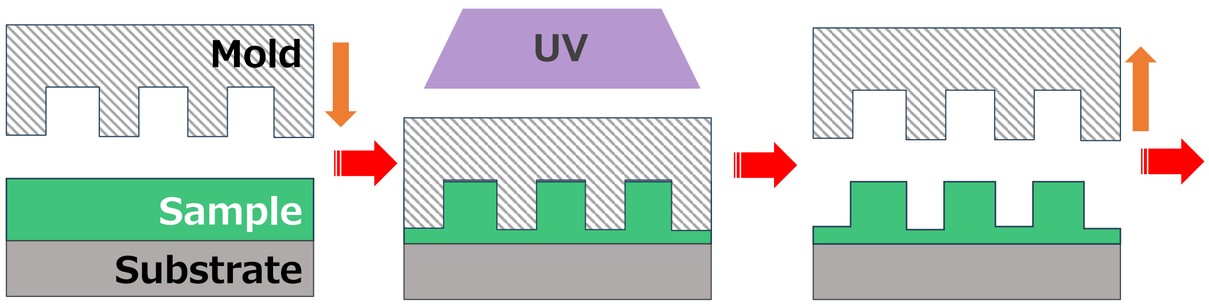
■ Target Applications

- **Metalenses** (Thin & Flat optical components)
- **DOE** (Diffractive Optical Elements)
- **Moth-eye Structures**
- **Replica Molds**

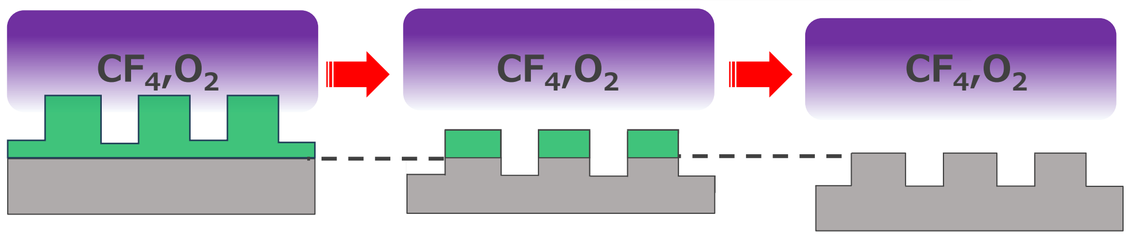




<Nanoimprint Process>

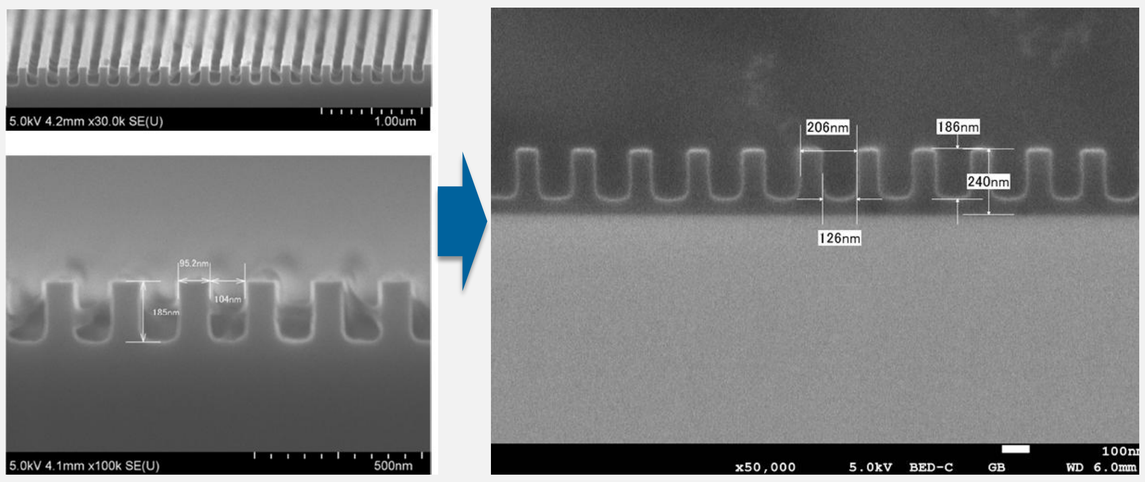


<RIE Process>



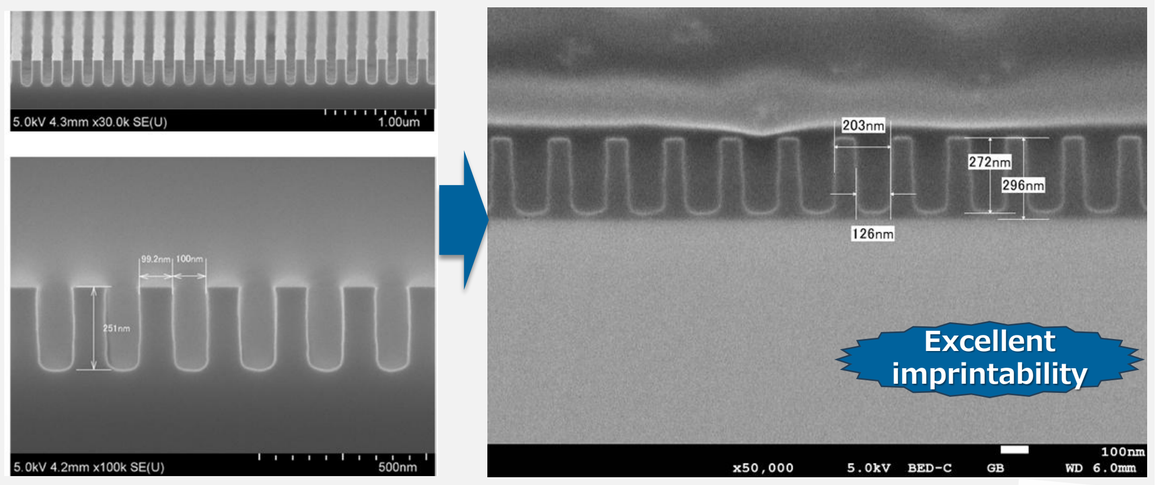
Si Mold
Depth 200nm/Width100nm

Imprinted resin structure



Si Mold
Depth 300nm/Width100nm

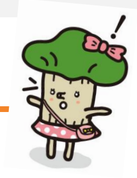
Imprinted resin structure

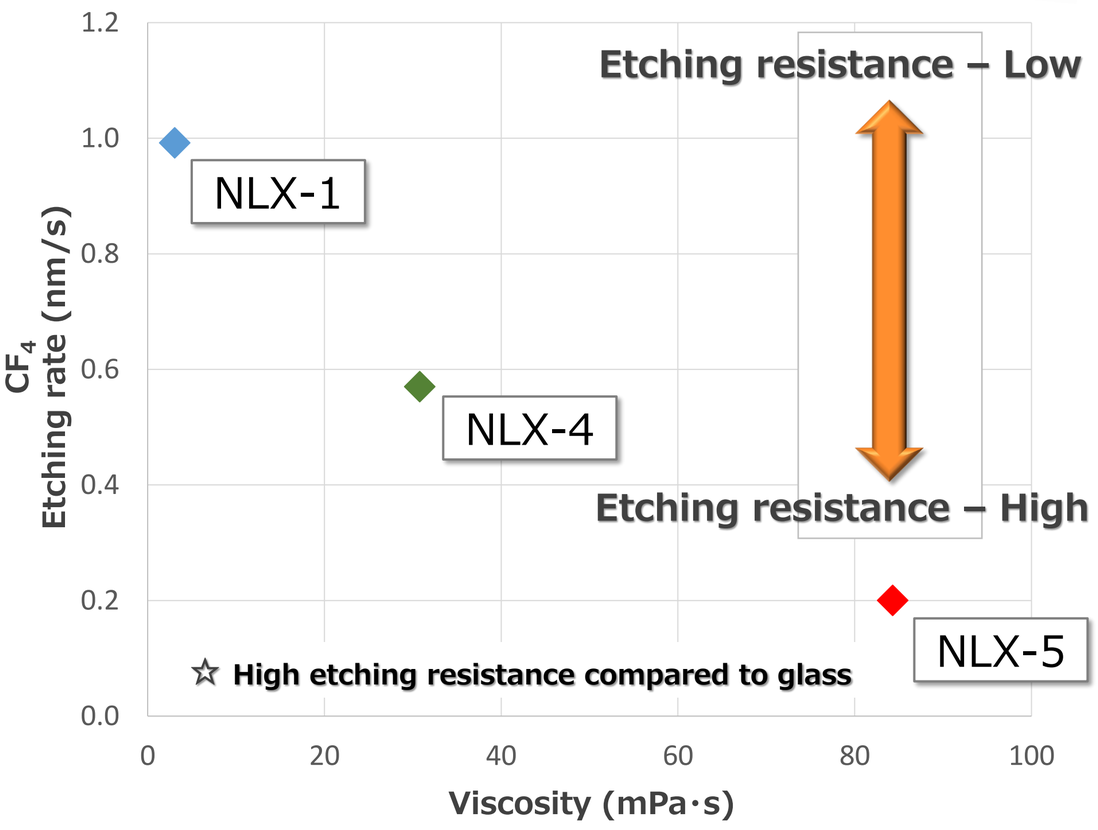


■ Technical Specifications

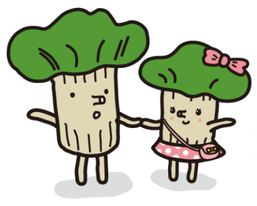
Sample		NLX-1	NLX-4	NLX-5
Features		**Low Viscosity**	**Low Viscosity/ Etching Resistance**	**High Etching Resistance**
Solid Content		50%	60%	60%
Solvent		PGMEA	PGMEA	PGMEA
Viscosity (mPa·s)	Liquid	3	5	7
	After Drying	15	30	85
Etching Rate (nm/sec)	CF_4	**1.0**	**0.6**	**0.2**
Adhesion	Glass	○	○	○
	Si Wafer	○	○	○

**For comparison, the SiO2 etching rate is 1.2 nm/sec*





☆ **PFAS-free versions available**



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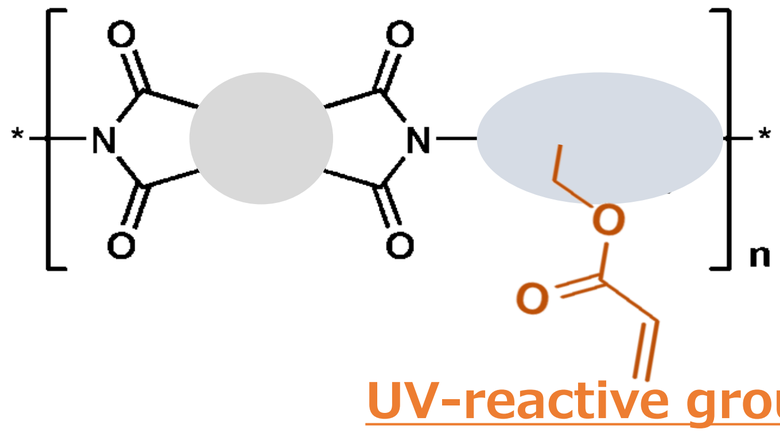
Photosensitive Polyimide Composition “PR-P4”

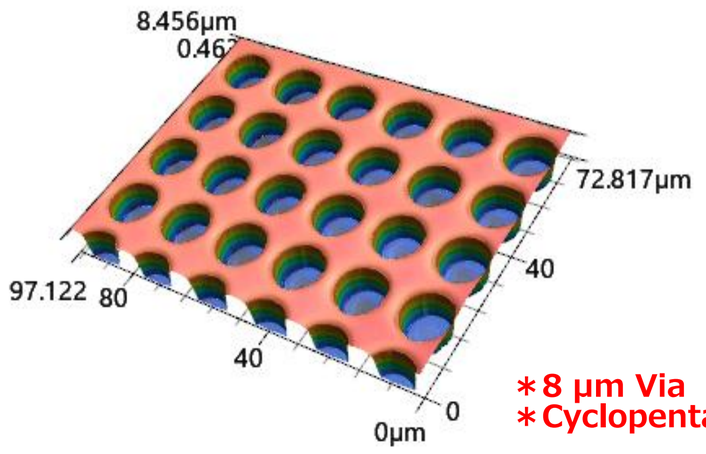
■ Product Overview

PR-P4 is a high-performance photosensitive polyimide material that balances **high heat resistance** and **high transparency**

- **Polyimide-derived Performance :** Offers excellent toughness, heat resistance and a low CTE
- **Process Efficiency:** The material is pre-imidized, eliminating the need for imidization
- **Fine Patterning:** Enables high-resolution patterning via UV irradiation and solvent development



<Patterning Example>

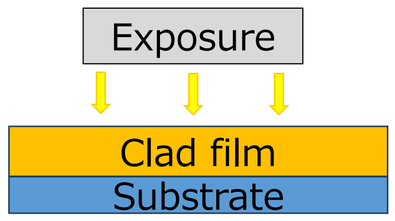


＊8 μm Via
＊Cyclopentanone development

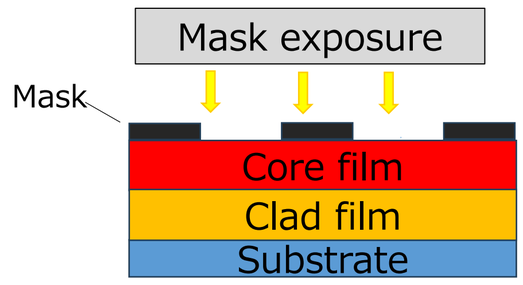
<Capable of forming optical waveguides>

Schematic diagram of optical waveguide fabrication

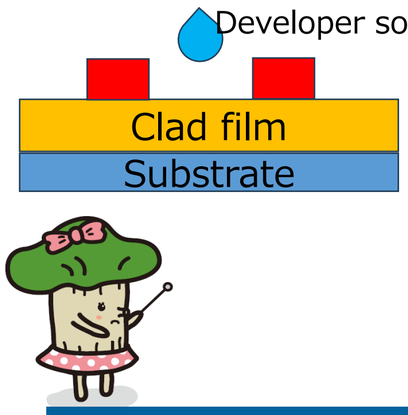
① **Clad Lamination:** Laminate the clad dry film onto the substrate and expose.



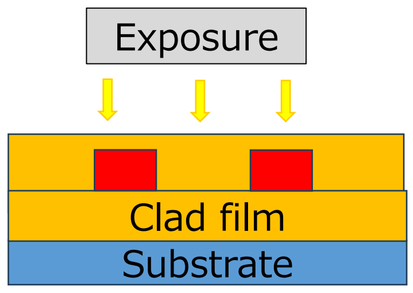
② **Core Lamination:** Laminate the core film and perform mask exposure.

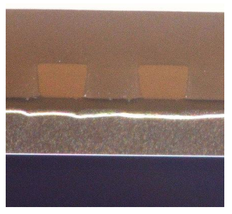


③ **Development:** Develop the core to create the waveguide pattern.



④ **Final Cladding:** Laminate the top cladding layer via thermocompression and perform final UV curing.





Cross-section of an optical waveguide

Simultaneous achievement of high heat resistance and high transparency

■ Target Applications

- **Optical Waveguides** (Core and Cladding materials)
- **Resist Materials** for semiconductor back-end processes
- **High Heat-Resistant Films**
- **Hollow Sealing Materials** for MEMS devices

■ Technical Specifications

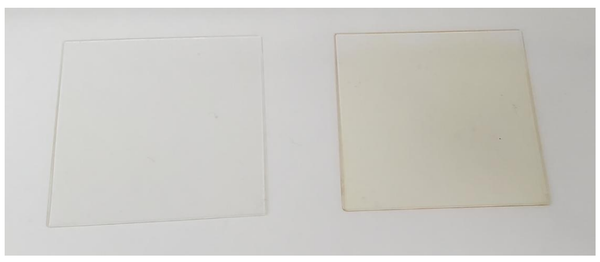
		PR-P4	Remarks
Liquid Property			
Solvents		Dimethylacetamide / Methylcyclohexane	-
Solid Content		Approx. 30%	Design value
Viscosity		400 mPa･s	E-type (@25℃)
Photoinitiator		Contained	-
Cured Film Properties			
Solvent Developability		○	Cyclopentanone (8μmVia)
Storage Modulus (GPa)	30℃	2.7	DMA
	175℃	1.4	
CTE (ppm/℃)		70	TMA
5% Weight Loss Temperature (℃)		370	TG-DTA
Elongation at break (%)		8	Tensilon
Shrinkage Rate (%)		8	CLSM (Dry to After-bake)
Transparency 850nm		99.5%	Initial & After 230℃×120min

＊Note: The values provided are representative and not guaranteed specifications

Substrate: Alkali-free glass or Release paper
Thickness: 10μm
Drying: 115°C for 5 minutes
UV Curing: 600 mJ/cm² (UV-A, ghi-line)
Post-Exposure Bake: 200°C for 60 minutes

<Liquid and Cured Film Appearance>

Liquid Appearance

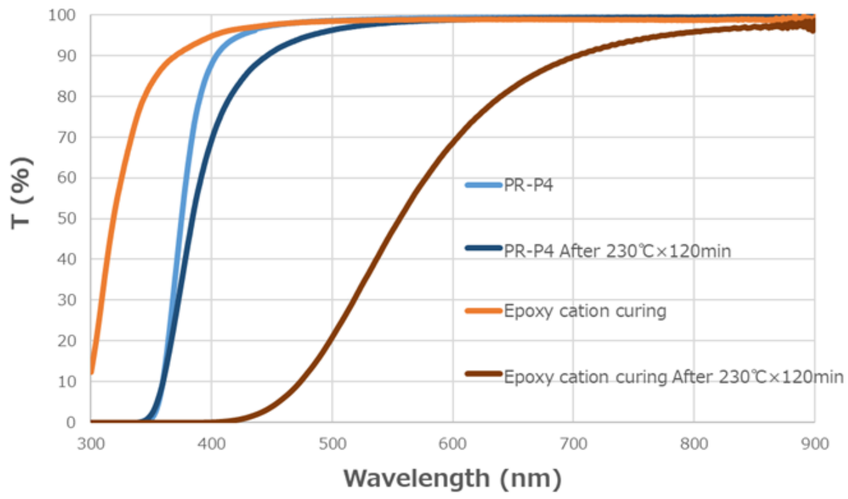


After UV Curing

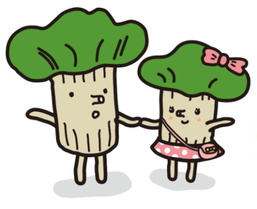
After 230℃×120min

Comparison Sample
Epoxy cation curing
After 230℃×120min

< Transmittance Chart >



☆ **High transmittance even after heating**



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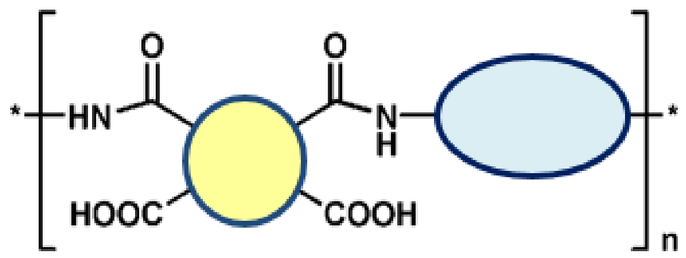
Water Based Polyamic acid solutions

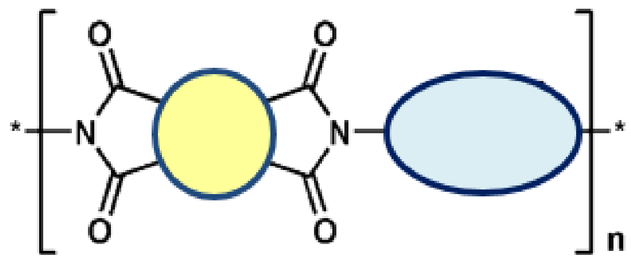
Features



Water Based Polyamic Acid Solution (Product)

Low Temp.
≧100℃

Imidization



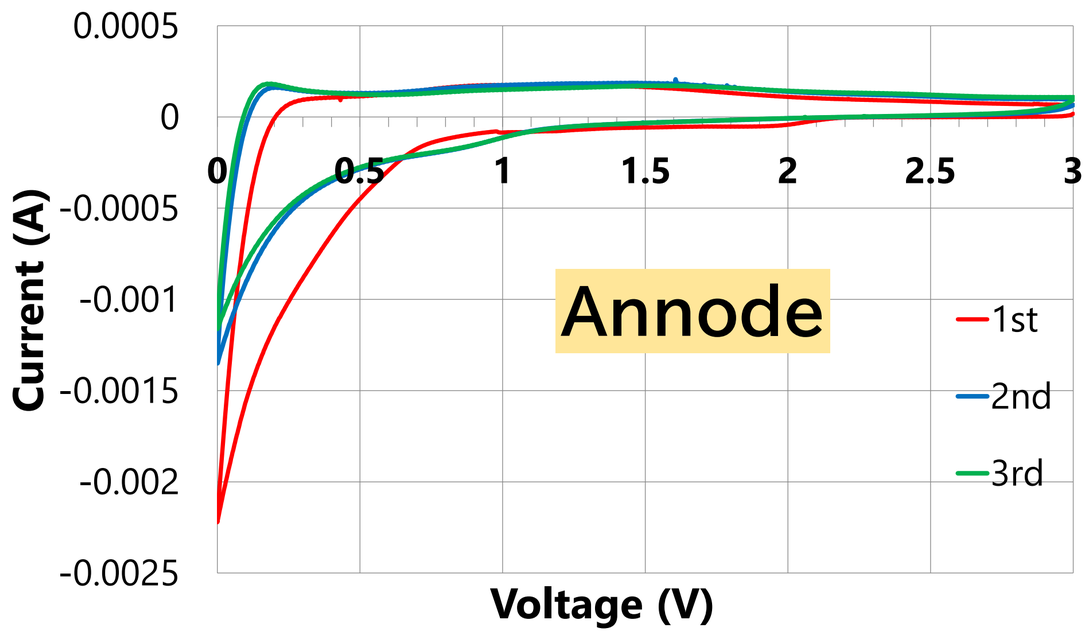
Polyimide

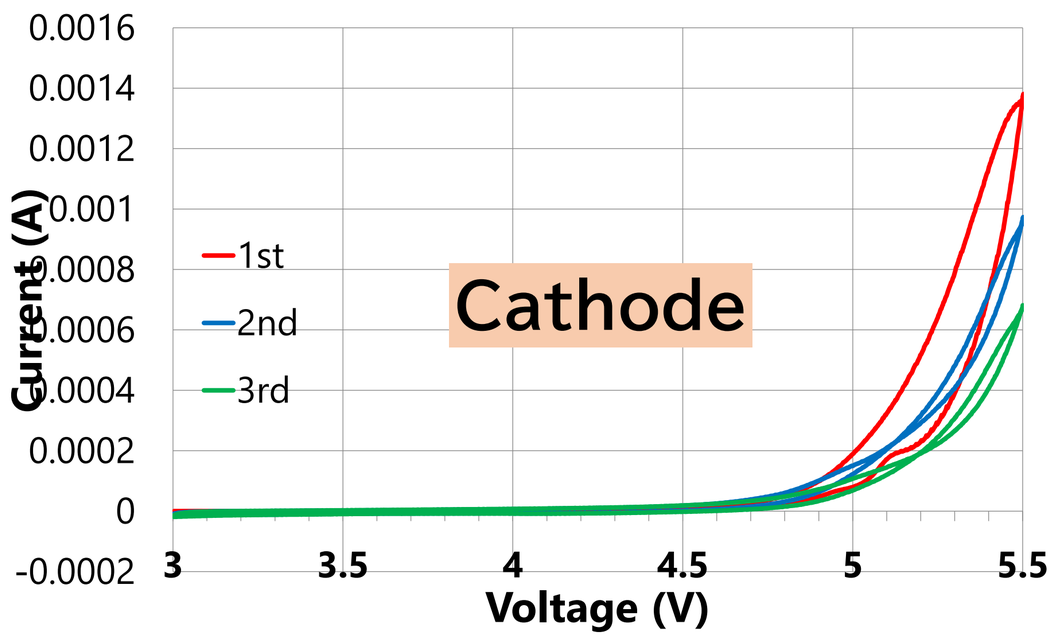
- ○Water solubele resin PFAS free⇒Ecofriendly ○Low Temp. Cure(≧100℃)
- ○High Thermal stability（Tg：130~320)
- ○High Chemical &Oxidation/Reduction stability
- ○High strength resin○High Breakdown Volatge(>300kV/mm)
- ○Good dispersibility(Si,SiC,SiO,Graphite,CNT・・・)

Appearance

Oxidation/Reduction stability

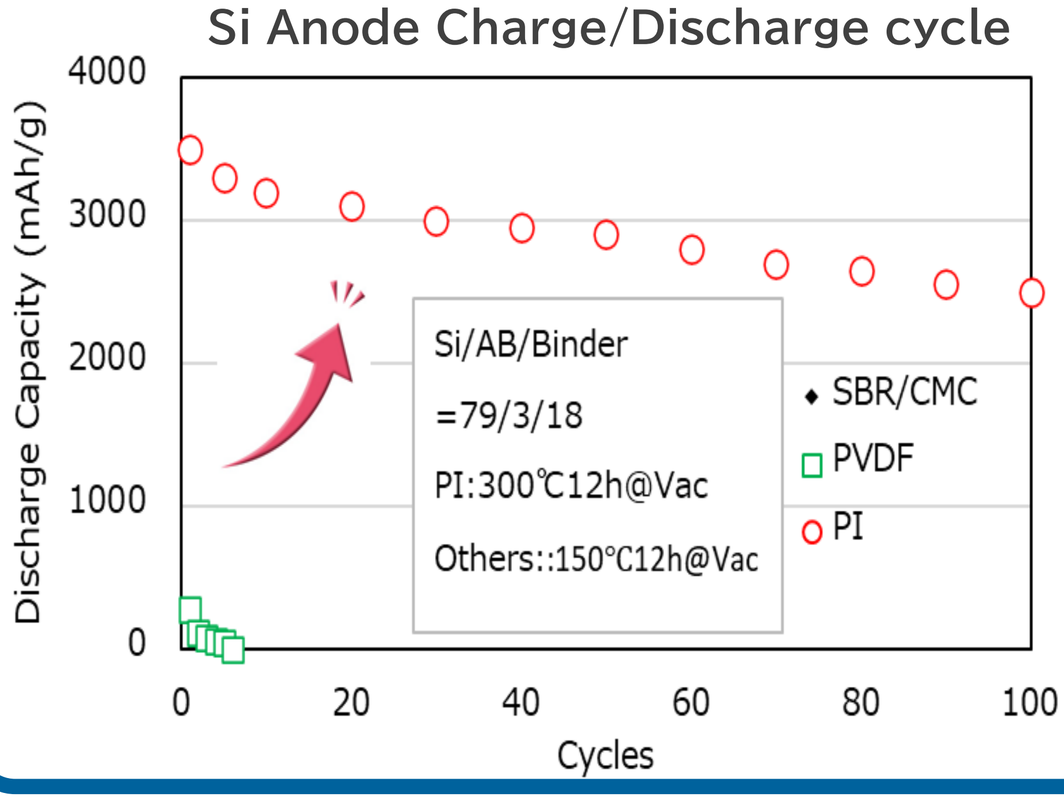
High Chemical and Oxidation/Reduction stability (Cyclic voltammetry)



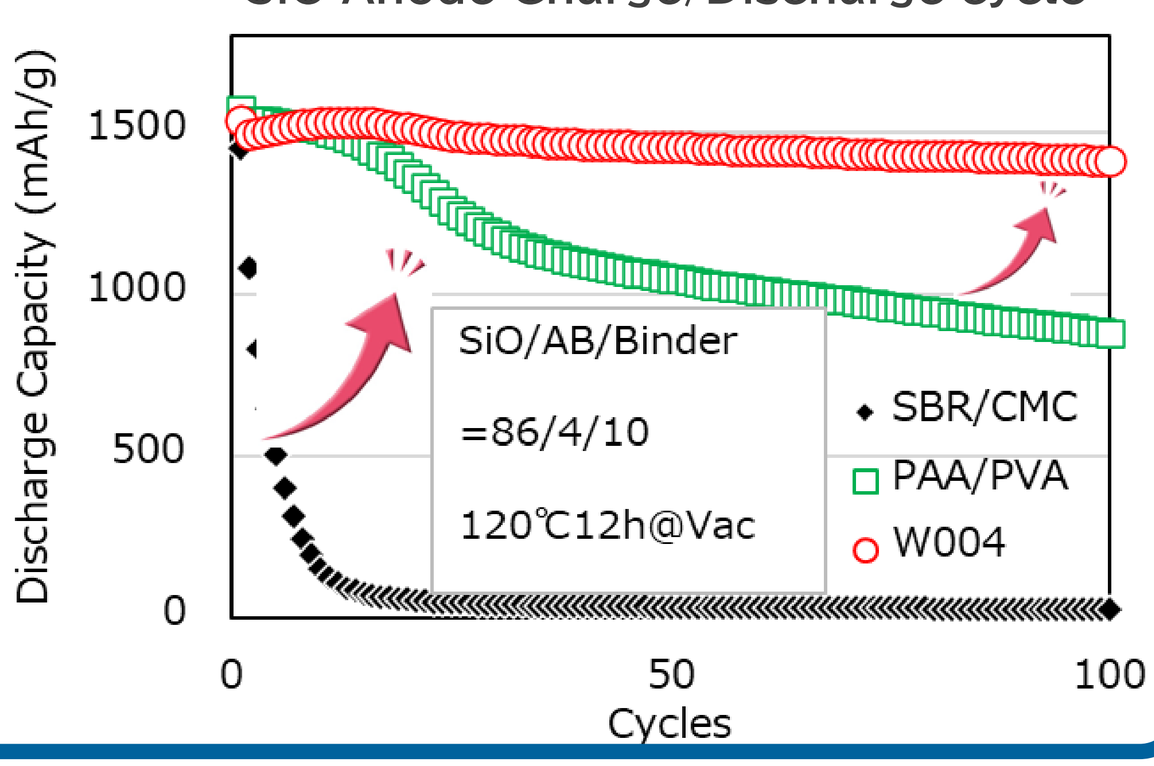


Battery Perfomance(Half Cell eavaluation)

Si Anode Charge/Discharge cycle



SiO Anode Charge/Discharge cycle

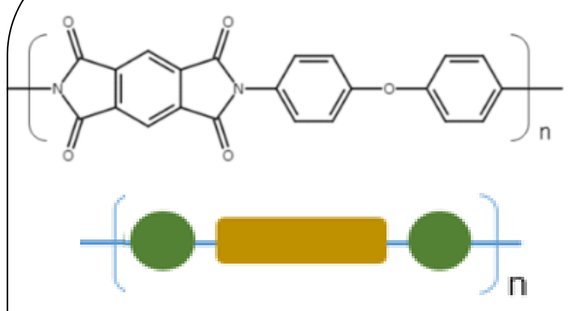


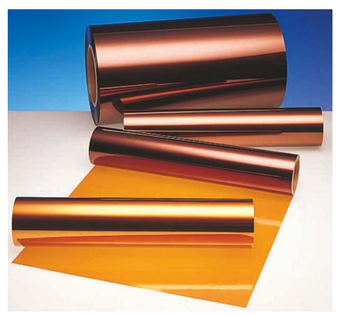
Varnish properties			Flim properties			
Non volatile (%)	Viscosity (Pa･s)	pH	Modulus (GPa)	Elongation (%)	Tg (℃)	Breakdown Voltage(kV/mm)
20-40	1-10	7-10	1-5	10-150	130-320	300-400

Thermoplastic solvent-soluble Polyimide resin solution

Features

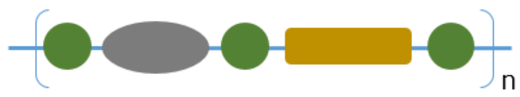
Conventional PI



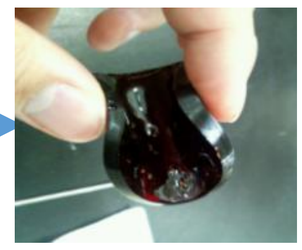


Good point : High Theemal resistance
Bad point : ・Bad processability (>300℃)
・High Water absorption (>1%)
・High Dielectric constant (>3)
・High Dissipation tangent (0.01)

Thermoplastic solvent-soluble Polyimide resin solution : Hard and soft moiety



Product



After Dry

- **Biomass material**
- **Good processability (Process Temp.:<180℃)**
- **Low water adsorption (<0.5%)**
- **Low Dielectric constant (2.7)**
- **Low Dissipation tangent (0.002)**
- **Good adhesion / Heat resistance**

→ For various application

: Imide : Aliphatic(soft) : Aromatic(hard)

Application

Material

Low Dk/Df Polyimide resin 「PIAD」

\+ Cross-linkers, Curing agents

\+ Filler

\+ Additives, etc..

Adhesives for high-frequency substrates

→Low dielectric, High heat resistance, High adhesion, High reliability

- Flexible Copper Clad Laminates
- Bonding Sheets (BS)
- Coverlay (CVL)
- Resin Coated Copper foil (RCC)

Binders for Lithium-ion batteries

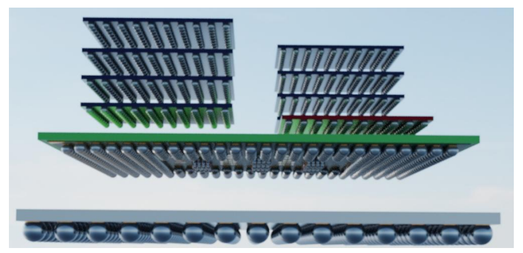
→High reliability, water-based, Low temperature curing

- Binders for electrode
- All solid state Battery
- Separator coating(Heat resistant@200℃)
- Insulation coating (Edge coating)

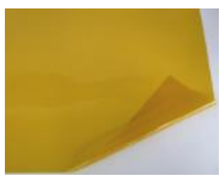
Resins for semiconductor back-end processes

Light curable, thermo-curable
→Low dielectric constant, Low elasticity, Low water absorption

- Resins for Redistribution layer (RDL)



FPCs



Cover lay

Bonding sheet

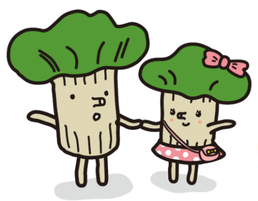
Main boards, Pakage substrates

Resin coated copper

Interlayer insulating film

Property (Varnish & Film)

試験項目		Unit	150L	300	13000	152H	252	605
Varnish	Main solvent	-	Cyclohexanone			Toluene		NMP
	Viscosity	mPa・s/25 ℃	400	600	4000	3000	700	8000
	Non voratile	wt %	29	30	20	42	33	26
Film	Maximum Stress	MPa	10.7	13.5	95	17.5	35.1	80
	Fracture Elongation	%GL	100 <	2.5	13	100 <	13.7	10
	Elastic Modulus	GPa	0.41	0.73	1.9	0.53	0.63	1.5
	Water absorption rate	%	0.2	0.4	-	0.1	0.2	0.3
	Dk@10GHz	-	2.6	2.7	3.0	2.5	2.6	2.7
	Df@10GHz	-	0.0023	0.0024	0.0055	0.0016	0.0017	0.0026
	Softening point	C deg.	80 / -	140 / -	- / 240	80 / -	100 / -	180 / 130
	Breakdown Voltage	kV/mm	52	47	-	45	45	73



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Pine Power to Fight Sliminess
Organic-based Biomass Anti-biofilm Agent

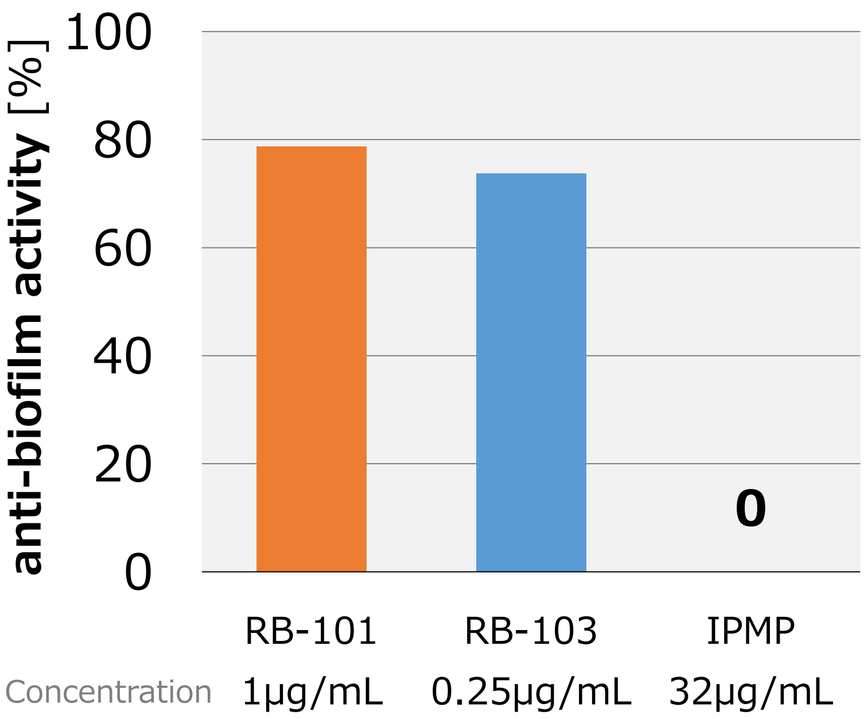
Features

Under Development

- ✓ Natural Materials (pine trees)
- ✓ High antibacterial and anti-biofilm activity
- ✓ Various Sample Forms
  (Plastics / Ink / Coating / Spray / Emulsion)

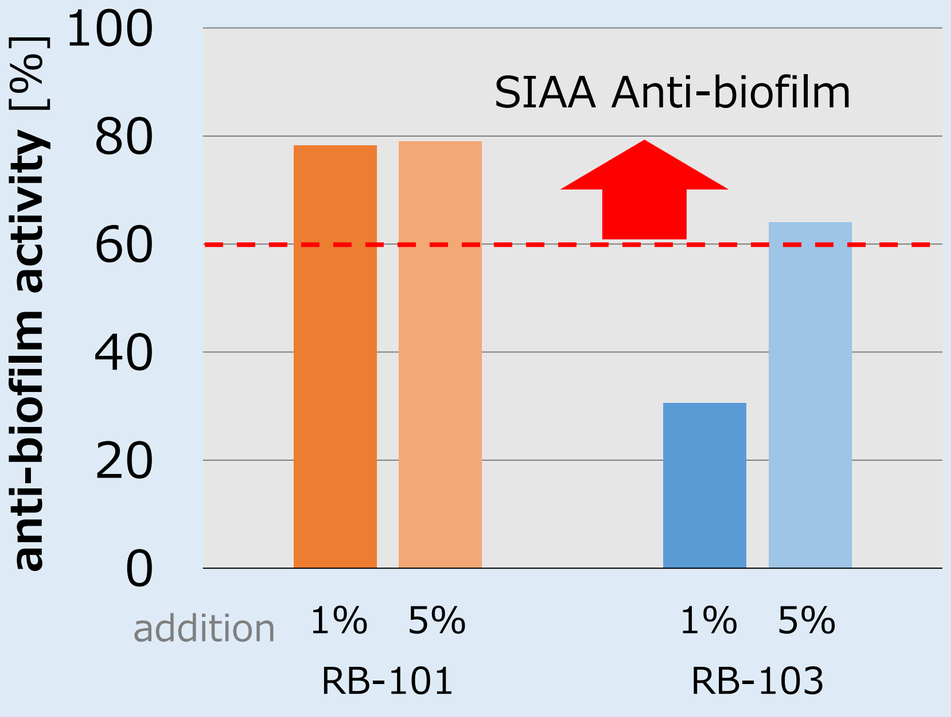
◆Anti-biofilm

S. mutans, ¼ concentration of MIC



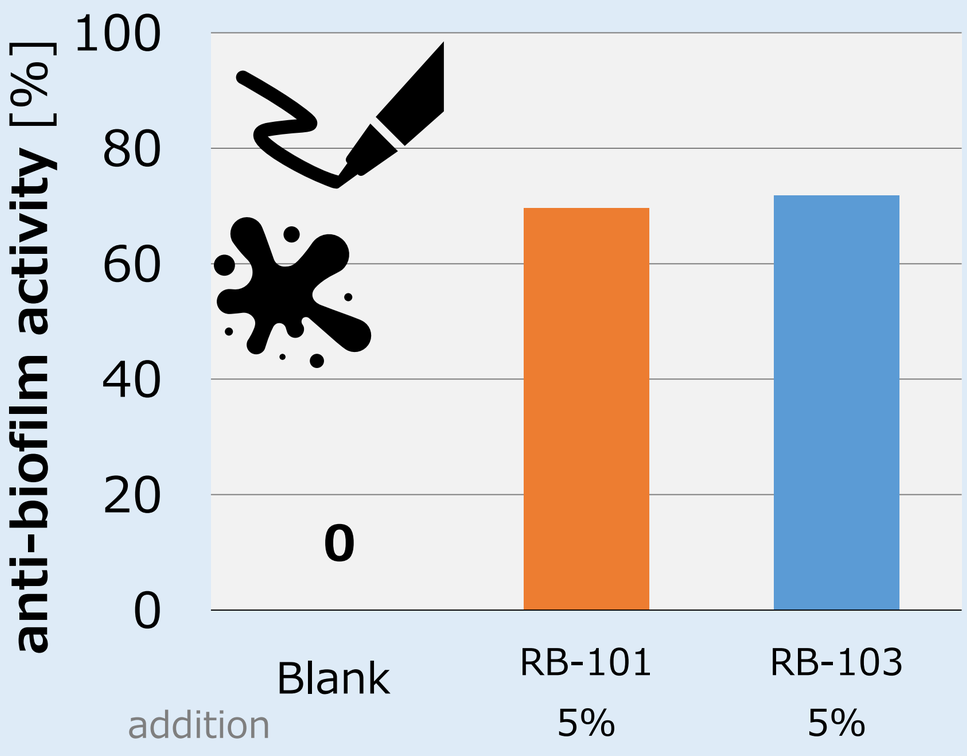
◆Anti-biofilm (Knead into PP)

Similar conditions to ISO4768



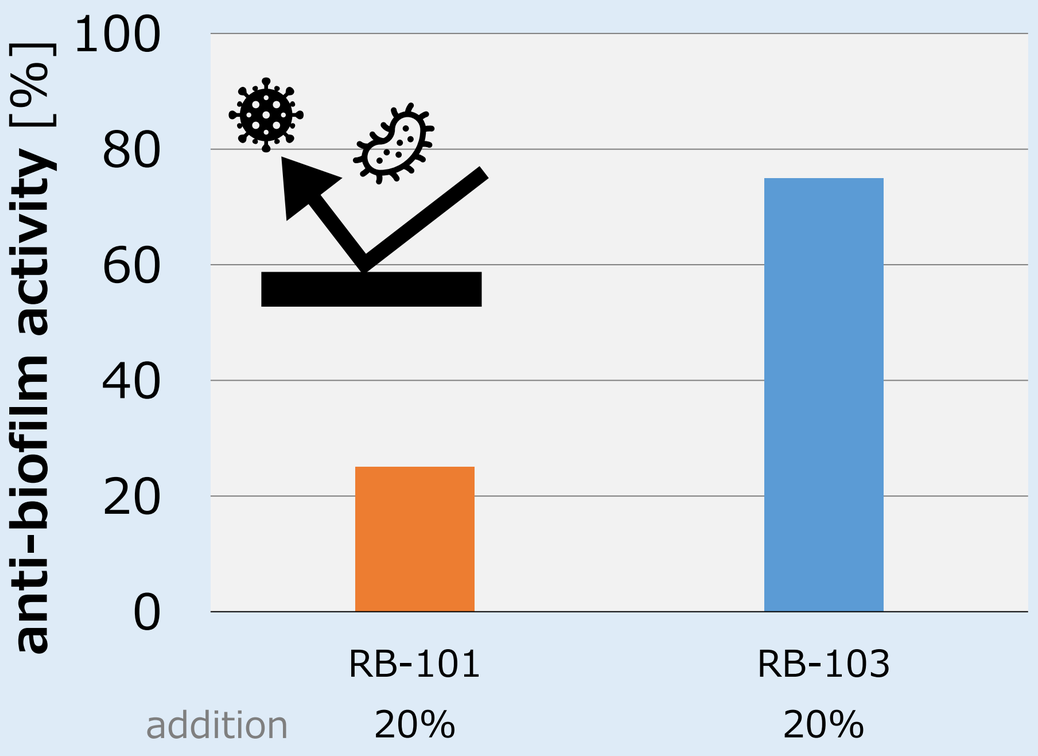
◆Anti-biofilm (added to ink)

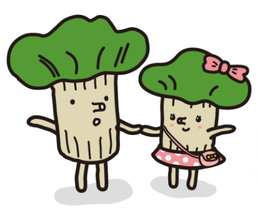
Added to acrylic-based ink, applied to film after
Similar conditions to ISO4768



◆Anti-biofilm (added to coating)

Added to UV coating agent, applied to film
After UV curing, similar conditions to ISO4768





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Dissimilar Materials Adhesion Enhancer
New Product 「Rosin polyol」

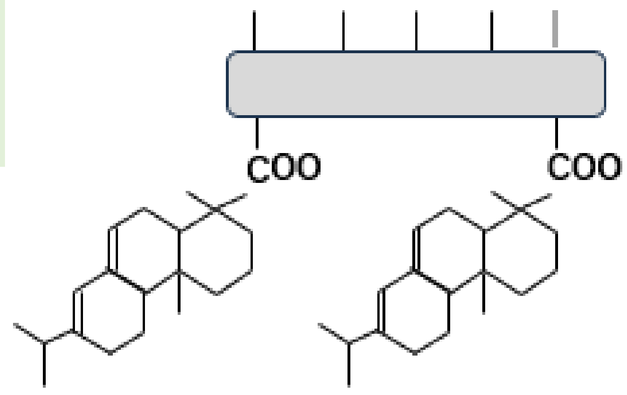
Features

✓ **Improved adhesion to difficult-to-bond materials**

✓ **Enhanced formability through reduced material viscosity**

✓ **Increased interfacial strength between dissimilar materials (resin/filler)**

Structure
(D-6011 : OH group at only terminal)

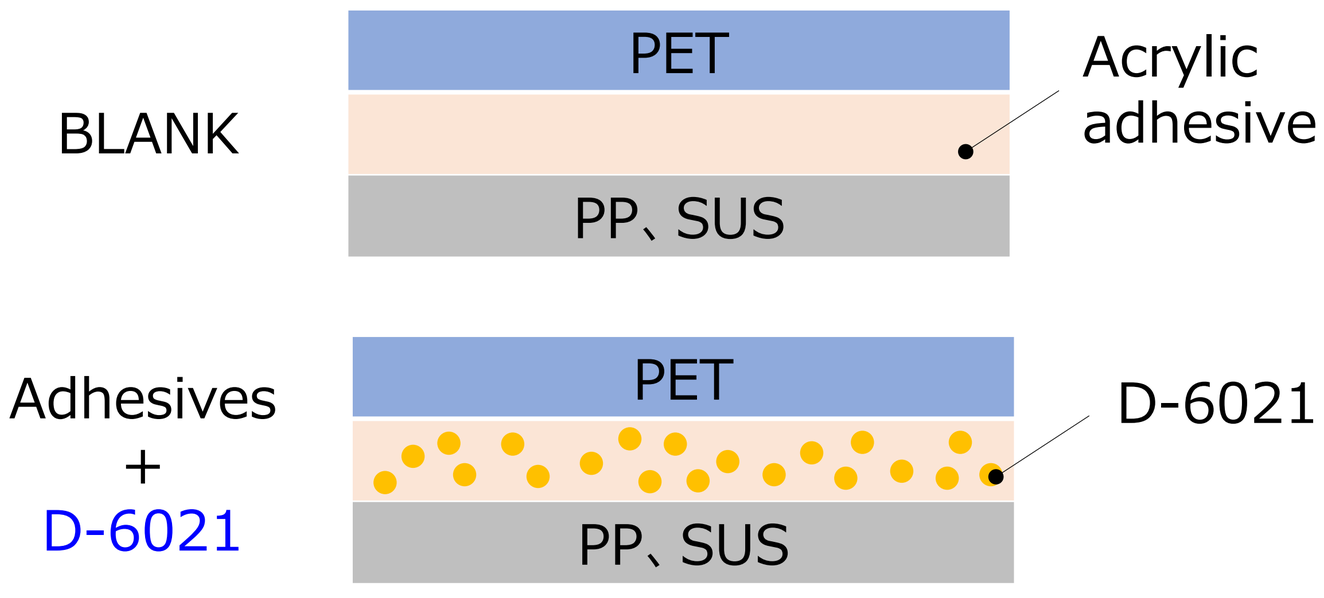


◆Product properties

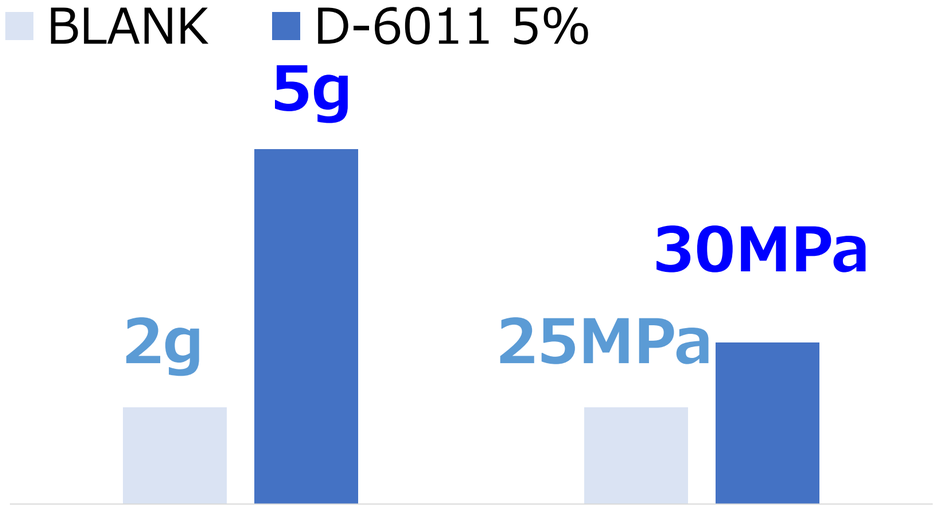
	D-6021	D-6011
Softening point （℃）	100	90
Acid value （mgKOH/g）	<1	<1
Hydroxyl value（mgKOH/g）	160	125
Molecular weight（Mw）	2000	800
Td5（℃）	380	360

Effect

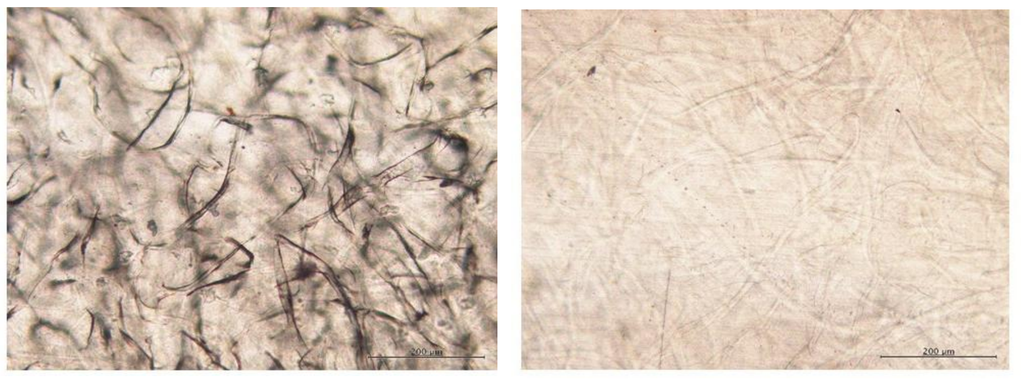
◆Effect on Adhesives



◆Effect on Resin/Filler Composites（Polyethylene/Cellulose ）



Optical microscope image



BLANK　　D-6011 compound