

## Ionic liquid CIL-313 as antistatic agent for ESD grade masterbatches

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1. Thermally stable
2. Electrochemically stable
3. Low vapor pressure
4. Non-volatile
5. Non-inflammable
6. Electrically conductive
7. Miscible with many kinds of organic solvents

## As a chemical for

- Fuel cells
- Electrodeposit on metals
- Solar cells (as electrolyte of dye sensitized solar cells)
- Sensors
- Super capacitors (as electrolyte of EDLC)

## In Polymer Chemistry

- Antistatic Additives for resin compounds or masterbatch

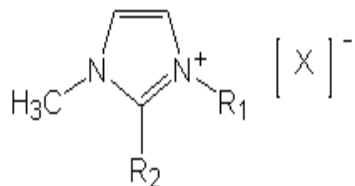
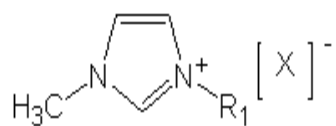
## Synthesis & Catalysis

- Immobilization of catalyst
- Solvents for organic reactions

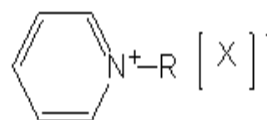
## Thermodynamic

- Thermal fluids

## Imidazolium type

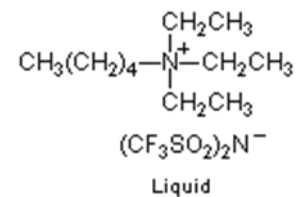


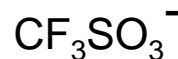
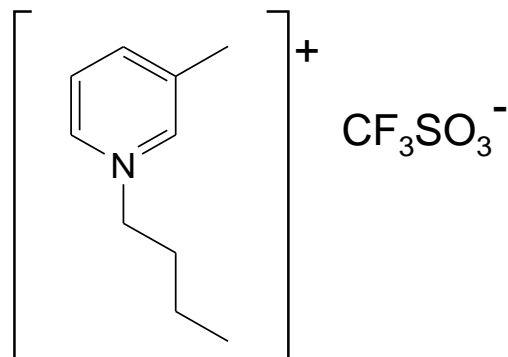
## Pyridinium type



↑  
CIL-313

## Ammonium type





Chemical Name : 1-Butyl-3-Methylpyridinium-Trifluoromethanesulfonate

Chemical Formula of CIL-313 :  $\text{C}_{11}\text{H}_{16}\text{F}_3\text{NO}_3\text{S}$

Molecular weight : 299.3 g/mol

Flash point: 275°C

Decomposition temperature: 315°C

Refractive index: 1.44~1.45 @25°C

Viscosity: 70 ~ 80 mPa · s@25°C

\* Not applicable for injection moldings of which temperature is higher than 270°C

\* CIL-313 complies with the RoHS

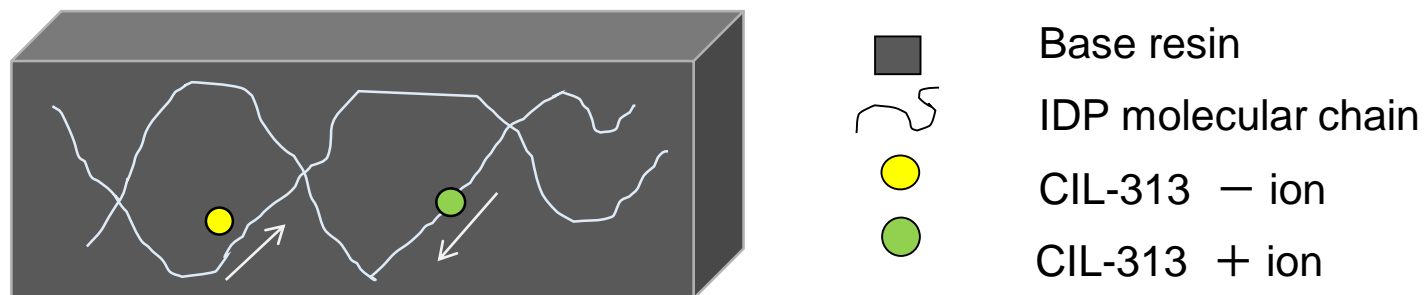
## Mechanism of conduction

High electrical conductivity appears when CIL-313 is used with IDP.

⇒ high ion mobility along with IDP polymer chain.

IDP: Inherently dissipative Polymer (resin w/ high polarity)

⇒ example: poly(ether ester amid) (Permanent antistatic agent)



\* CIL-313 will not bleed out because CIL-313 has strong interaction with IDP.

1. Carbon fiber (typically used)

✗ Stable control of resistance is difficult.

✗ It gives you black color only.

\* Typical surface resistance for ESD purpose is  $10^6 \sim 10^9 \Omega$ .

2. IDP+CIL-313

✓ Use IDP only (15% addition to base resin)  $\Rightarrow 10^{10} \sim 10^{12} \Omega$

✓ Use IDP and CIL-313  $\Rightarrow 10^7 \sim 10^9 \Omega$  (ESD grade).

Possible to have transparent or color compound for ESD grade.

**Example of IDP (Permanent anti-static agent) manufacturer**

Company name (product name)

BASF (Irgastat), Dupont (Entira), Arkema (Pebax), Lubrizol (Stat-rite)

Sanyo chemical industry (Pelestat and Pelectron)



### ① For use with vinyl chloride (PVC)

Add CIL-313 0.3wt% only  $\Rightarrow$  surface resistance  $10^9\Omega$

\* Since PVC is high polarity resin, IDP assistance is not necessary.

### ② For use with PP, PE, PS, PC, PBT, POM, PMMA, PA6, PET-G, TPU

Add CIL-313 0.5wt% and IDP 10wt%  $\Rightarrow$  surface resistance  $10^7 \sim 10^9\Omega$

\* The molding processing temperature must be lower than  $270^\circ\text{C}$ .

(thermal resistance of CIL-313 is up to  $270^\circ\text{C}$ )

† CIL-313 can NOT be used for food and medical packaging.

(CIL-313 is not approved by FDA.)

Industrial use only (e.g. used for electric parts packing etc.)

1. CIL-313 has been used in a major chemical company in combination with ABS in Japan.

- \* CIL-313 can not be used with ABS only because of patent right in Japan.
- \* Other resin compounds and polymer alloy with ABS have no such issue.

2. CIL-313 is used by U.S. based chemical company for ESD grade color PC and TPU compound in Singapore.

- \* Surface resistance required for ESD was achieved for PMMA, PA6, PET-glycol in this company.

## Cost comparison of permanent anti-static agents

	Carbon Black	Carbon Fiber	IDP + CIL-313	IDP
Unit price / kg	USD3	USD28	IDP USD28 CIL USD450	USD28
Amount of addition	18wt%	10wt%	IDP 10wt% CIL 0.5wt%	15wt%
Anti-static agent cost / resin-1kg	USD0.5	USD3	USD5	USD4
Surface resistance	$10^3 \sim 10^5 \Omega$	$10^6 \sim 10^8 \Omega$ ESD grade	$10^7 \sim 10^9 \Omega$ ESD grade	$10^{10} \sim 10^{12} \Omega$
Color	black only	black only	Colorable or Transparent	Colorable or Transparent

\* The costs shown above are typical examples.

\* This method is suitable when colorable or transparent ESD compound is indispensable.

- ✓ OA machine parts,
- ✓ carrying trays for HDD platters and other parts, Si wafers,
- ✓ equipment for semiconductor fabs,
- ✓ electronic parts packing,
- ✓ parts of explosion-proof equipment for use in mines etc.

1. New permanent antistatic agent for masterbatch.  
(Compound of base resin, IDP and CIL-313)
2. New ESD grade transparent or color compound master batch.  
(Compound of base resin, IDP and CIL-313)

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