Ionic liquid CIL-313 for ESD resin compound

Contents

1. Thermally stable
2. Electrochemically stable
3. Low vapor pressure
4. Non-volatile
5. Non-inflammable
6. Electrically Conductive
7. Mixable with organic and solvent

Chemical for

- Fuel cells
- Electrodeposit on metals
- Electrolyte dye sensitized solar cells (DSSCs)
- Sensors
- Super capacitors

Polymer Chemistry

- Additives for resin compound

Molecular structures of some ionic liquids

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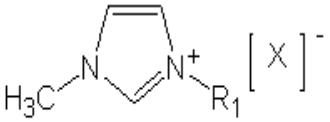
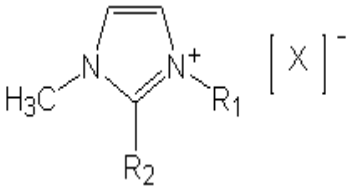
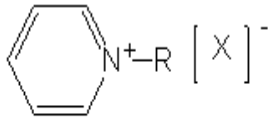
Imidazolium type



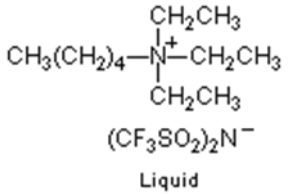


Pyridinium type



CIL-313

Ammonium type



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Physical properties of CIL-313

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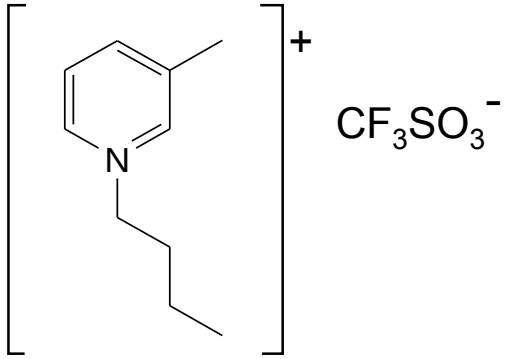


Chemical Name : 1-Butyl-3-Methylpridinium-Trifluoromethanesulfonate

Chemical Formula of CIL-313 : $C_{11}H_{16}F_3NO_3S$

CIL-313 complies with the ROHS

Molecular weight : 299.3 g/mol

Flash point: 275℃

Decomposition temperature: 315℃

Refractive index: 1.44~1.45 @25℃

Not applicable for injection moldings of which temperature is higher than 270℃

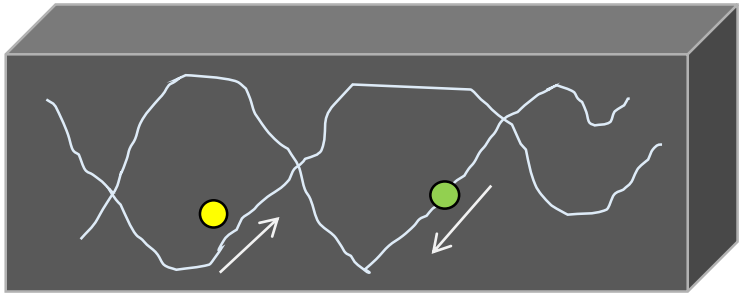
Mechanism of conduction

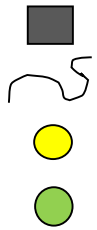
High electrical conductivity appears when CIL-313 is used with IDP.

⇒ high ion mobility along with IDP polymer chain.

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

⇒ example: poly(ether ester amid) (Permanent anti-static agent)





Base resin

IDP molecular chain

CIL-313 - ion

CIL-313 + ion

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

Materials for ESD (Electro Static Discharge)

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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) ⇒ $10^{10} \sim 10^{12} \Omega$

✓ Use IDP and CIL-313 ⇒ $10^7 \sim 10^9 \Omega$ (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 ⇒ 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% ⇒ surface resistance $10^7 \sim 10^9\Omega$

* The molding processing temperature must be lower than 270℃.
(thermal resistance of CIL-313 is up to 270℃)

† 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.)

Business deployment of CIL-313

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

* CIL-313 can not be used only with ABS because of patent right.

* Other resin compounds and polymer alloy with ABS have no such issue.

2. Used by U.S. based chemical company for ESD 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

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	Carbon Black	Carbon Fiber	IDP + CIL-313	IDP
Unit price / kg	USD3	USD28	IDP USD28 CIL USD600	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~$10^5\Omega$	10^6~$10^8\Omega$ ESD grade	10^7~$10^9\Omega$ ESD grade	10^{10}~$10^{12}\Omega$
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.

Application of plastic parts w/ CIL-313

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- ✓ OA machine parts,
- ✓ carrying trays for HDD and Si wafers,
- ✓ equipment for semiconductor fabs,
- ✓ electronic parts packing,
- ✓ parts of explosion-proof equipment for mine etc.

Opportunities for plastic parts manufacturer

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1. New permanent anti-static agent pellet.
   (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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