



Polyimide Film for Tape Applications

Presented by:

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The presentation represents the speaker's views individually and does not necessarily reflect the company's viewpoints



TAPE
WEEK
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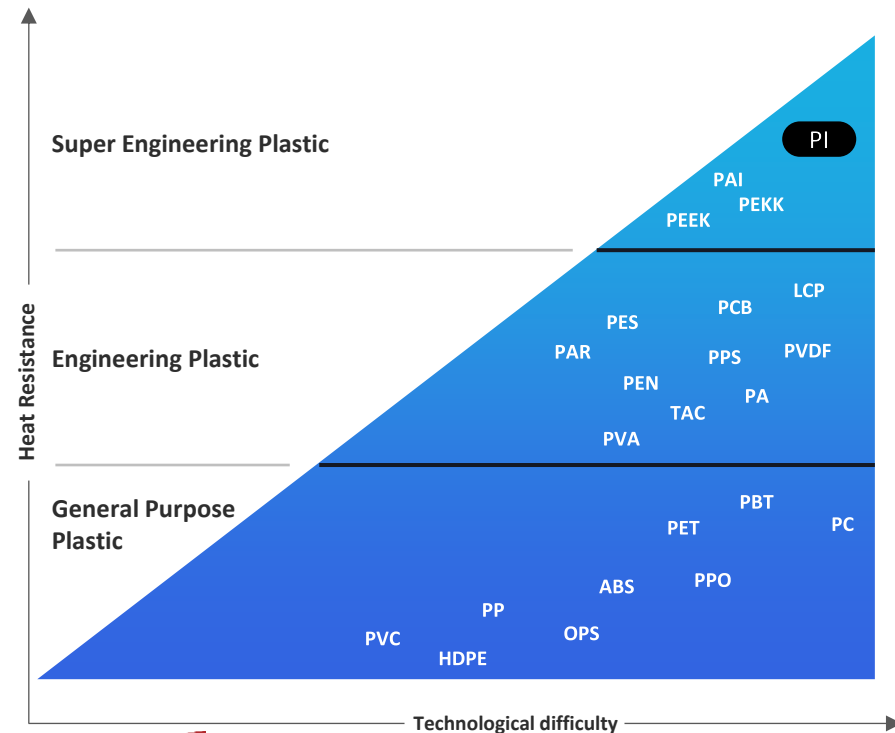
Outline

- Introduction to High Performance Polymers
- Introduction to Polyimide
- Applications of Polyimides
- New Developments of Polyimides

High-Performance Polymers for Tape

Key Characteristics

- Super engineering plastic with outstanding thermal resistance ($-269^{\circ}\text{C} \sim 400^{\circ}\text{C}$), electrical insulation, dimensional stability and processability

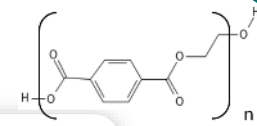


Polymers in Tapes

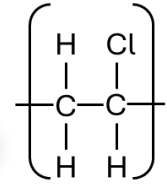
Polyimides



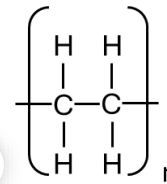
PET



PVC



PP/PE



Polyimide in Advanced Applications



EV

- Tape (Inside Battery Cell)
- Tape for Bus Bar Insulation
- Film for Slot Liners
- Functional Tape for High Voltage Motors (> 1000 V)



Aerospace

- Film for Insulation
- Film for Shims
- Film for MLI Blanket



Advanced and Industrial

- Film for HT°C Labels
- Film for High V insulation
- Film for Semiconductor



Heat resistance



Insulation



Flexibility

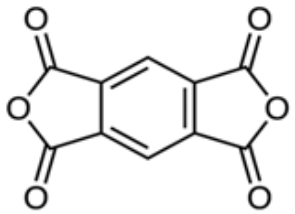


Dimensional stability

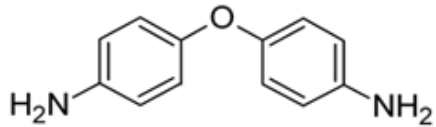
Types of PI: Chemistry Drives Performance

Standard PI generally based on:

Diamine + Dianhydride = Polyimide



PMDA

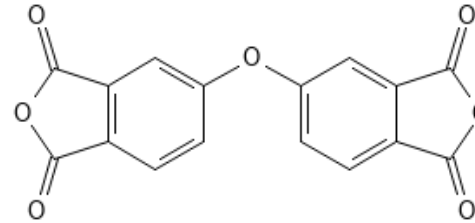


ODA

Alternative Polymer Compositions Can Be Developed:

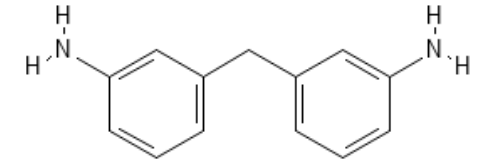
Various performance characteristics can be tailored via potential monomers

Dianhydrides

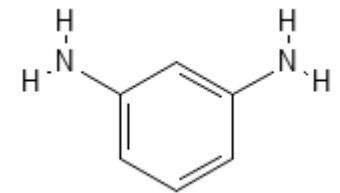


ODPA

Diamines



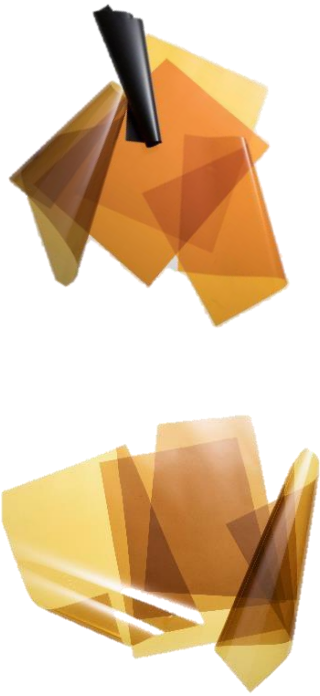
MDA



MPDA

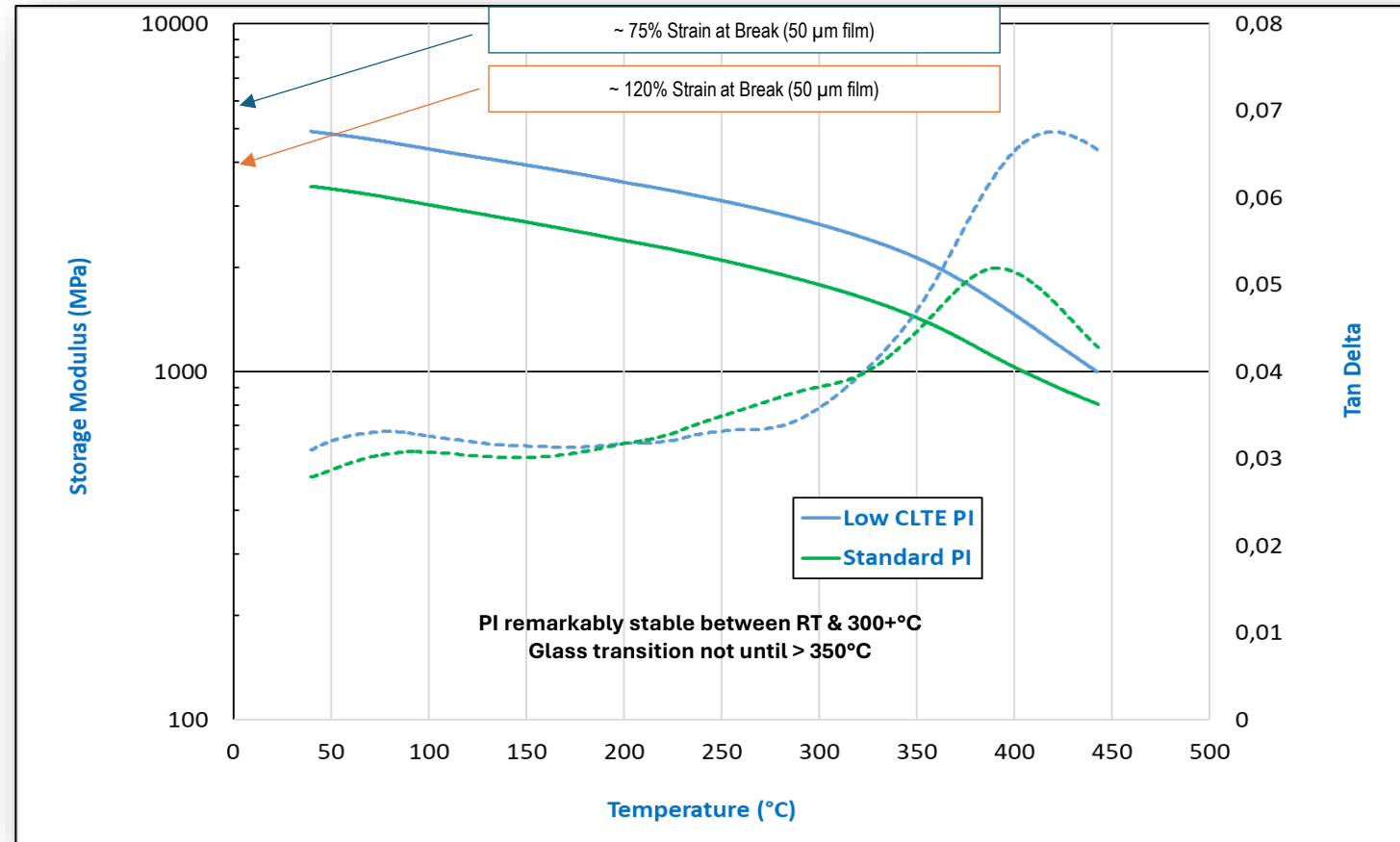
Polyimide is a general term for a wide range of ultra high-performance polymers. The polymer structure critical for achieving the KPI's for the applications

Types of PI: Tailored for Applications



Type of PI	Thermal Resistance	Strength	Modulus	Dimensional Stability	Electrical Properties	Application Examples
Standard	+	+	+	+	+	Tape and Label
Stiffness	+	+	++	++	+	FCCL Coverlay Stiffener
Low Df (dissipation factor)	++	+	++	+++	++	5G Antenna
Low CTE (Coefficient Thermal Expansion)	++	+++	+++	+++	+	Flex-Solar Pannel, Chip on Film
Corona Resistant	+	+	++	+	++	Motor, Electrical

High Temperature Performance of PI Films



Polyimides show excellent thermomechanical properties through elevated temperature environments

Historical: Tapes and Labels



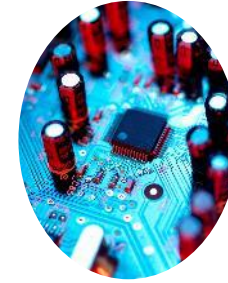
PI Film



Tape/Label



Electronics Manufacturing



Electrical Applications



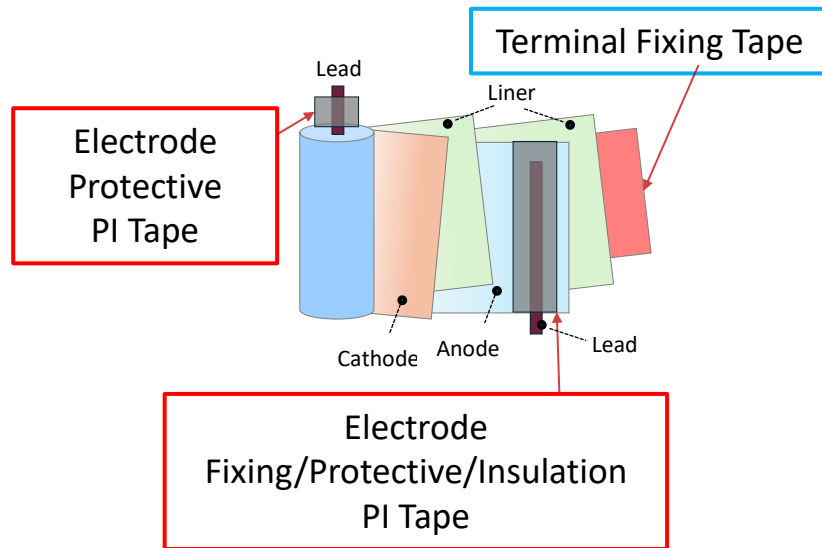
Aerospace/transportation



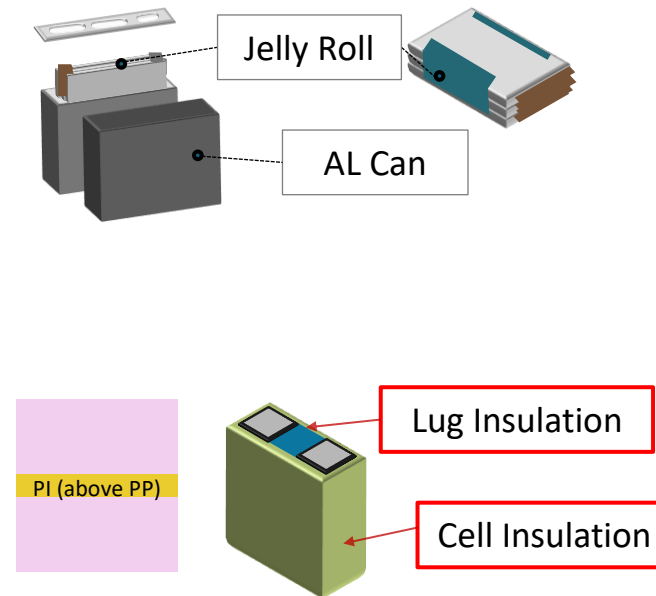
- Long history of PI film used in tapes and labels
- Thermal and chemical resistance in aggressive process environments
- Low flammability key driver

PI Film for EV Battery tape

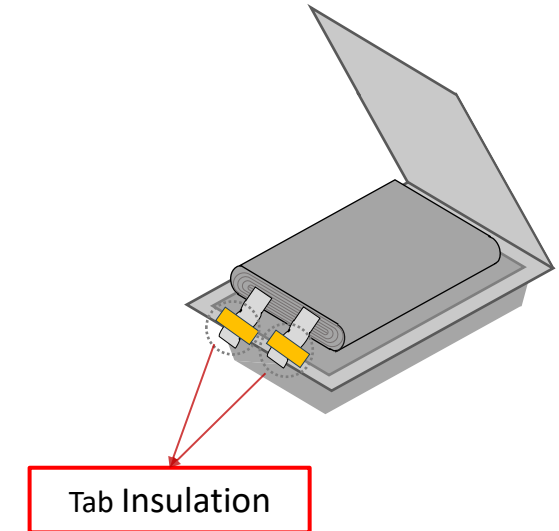
1) Cylindrical



2) Prismatic

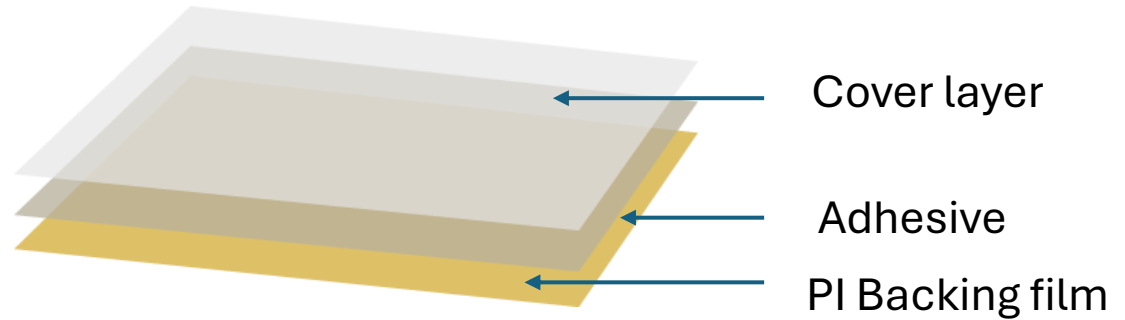
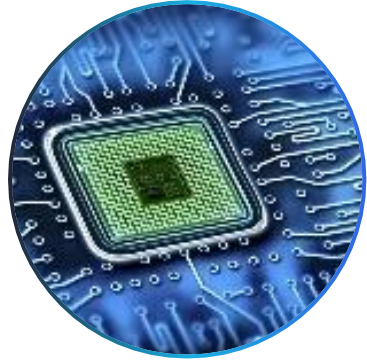


3) Pouch



Polyimide properties make it an excellent material for demanding environments in battery applications

Semiconductor Packaging and Processing

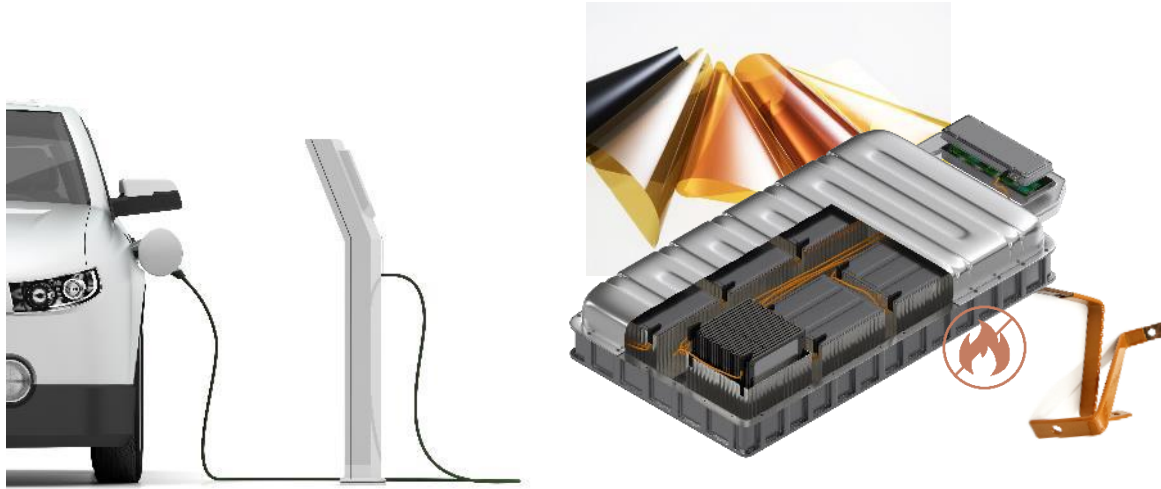


Electrical packaging of chips for protection from external environments and for connection between terminals.

Applications:

- **Quad Flat No Lead (QFN) Tape:** High-heat-resistant adhesive tape attached to the back of the lead frame in semiconductor packages to prevent EMC molding leakage.
- **Lead On Chip (LOC) Tape:** High-heat-resistant double-sided adhesive tape used to bond the lead frame and chip in memory semiconductor packages.
- **Lead Lock Tape (LLT):** Thermosetting single-sided polyimide tape used to prevent deformation of fine pitch, high pin count lead frames in non-memory semiconductors such as MQFP and TQFP.

EV: Battery Pack Insulation and Busbars



Demanding Applications Aligns with PI Value



Extreme Fire resistance



Electrical Properties



Advanced Thermal Properties



Chemical Resistance



Flexibility

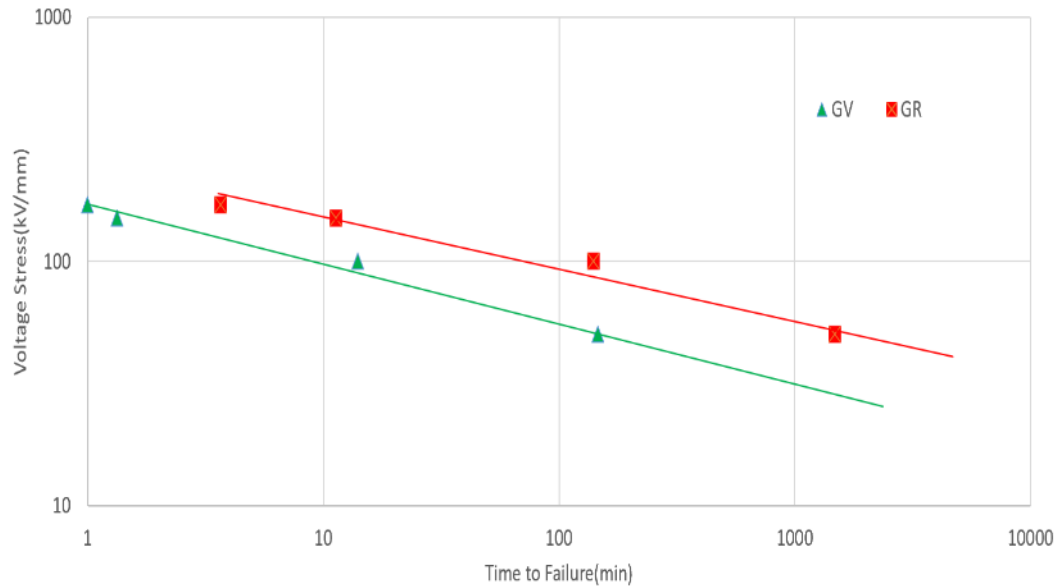
- **Power:** Increasing adoption of 800V platforms for fast charging
- **Safety:** Thermal runaway protection- UL 94 and FST protection

New Developments: Corona Resistance For Motor applications

→ Advantages of increased Corona Resistance

- Thinner (40%)
- Increase Copper Fill Factor
- Breakdown Voltage
- Sharper Angles (Forming)
- Ease of Insertion & Fill Factor
- Cost competitive
- Customizable
- Corona Resistance
- Heat Conductivity

Voltage Endurance



New developments in corona resistant polyimide films increases voltage endurance 10-fold while maintaining excellent mechanical properties

Ultra-Thin Polyimide Film: 4 Micrometers (μm)



4-micrometer film, which is approximately 1/25th the thickness of a human hair, is both lightweight and flexible, making it outstanding for miniaturizing components

Conclusions

- Polyimides play an essential role in high performance tapes
- Key properties make it the superior backing film for demanding environments: thermomechanical stability, low permittivity, low CTE
- New platforms and applications such as battery, electric vehicles, and semiconductors will be supported by polyimides
- New developments in PI films will be critical to support these future applications – what is missing from your perspective?

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