

Why ODPA Is Used in High-Performance Polyimide Materials



Shanghai, China Aug 26, 2026 ([Issuewire.com](http://www.Issuewire.com)) - 4,4'-Oxydiphthalic anhydride, commonly abbreviated as ODPA, is an aromatic dianhydride used as a structural monomer in polyimide chemistry. Its importance in high-performance polymer design does not come from one isolated property. It comes from the combination of aromatic structural units, two anhydride functionalities and an ether linkage within the same molecule.

4 4-Oxydiphthalic anhydride ODPA CAS 1823-59-2

Starsky Chemical identifies its ODPA product as CAS 1823-59-2, with the molecular formula C₁₆H₆O₇

and a molecular weight of 310.21 g/mol. The current product specification describes the material as a white powder with purity of $\geq 99\%$ and a melting-point range of 225–229°C. Its stated application is the preparation of polyimide material.

For polymer engineers, however, the more useful question is not simply whether ODPA can be used to make a polyimide. It is why its molecular structure is selected and how the ODPA-derived unit interacts with the diamine and the rest of the polymer architecture.

ODPA should therefore be viewed as a backbone-forming dianhydride monomer, rather than as an additive that independently delivers a fixed level of thermal, mechanical or dielectric performance.

Why Is ODPA Used as a Dianhydride Monomer in Polyimides? The two anhydride functionalities in ODPA define its role in polyimide chemistry.

Polyimides are built from complementary multifunctional monomers. Aromatic dianhydrides contribute one structural part of the polymer backbone, while diamines contribute another. Once the polymer is formed, the molecular structures of both monomers are incorporated into the repeating architecture.

This makes ODPA fundamentally different from a conventional modifier added to an existing polymer.

Dianhydride Functionality ODPA belongs to the aromatic tetracarboxylic dianhydride family.

Its two cyclic anhydride functionalities allow it to serve as the dianhydride component of a polyimide monomer system. The ODPA-derived portion therefore becomes part of the main polymer chain rather than remaining as a separate additive phase.

This distinction matters because the geometry of the original monomer contributes directly to the geometry of the resulting polymer backbone.

Aromatic Framework ODPA also contains aromatic structural units.

Aromatic groups are common in high-performance polyimides because they provide relatively rigid molecular frameworks compared with many flexible aliphatic structures.

That rigidity can contribute to the overall thermal and dimensional behavior of a finished polymer. It should not, however, be interpreted as evidence that ODPA alone determines heat resistance.

The corresponding diamine, molecular weight, intermolecular interactions, morphology and processing history remain important.

Ether-Linked Architecture The defining feature that distinguishes ODPA from several other aromatic dianhydrides is the oxygen linkage connecting its aromatic structural units.

This Ar–O–Ar architecture introduces a different degree of conformational freedom from a completely rigid, directly connected aromatic structure.

ODPA therefore combines two characteristics that are often considered together in polymer design: aromatic rigidity and ether-linked molecular mobility.

The technical value lies in the balance between them rather than in either characteristic alone.

How ODPA Becomes Part of the Polyimide Backbone A useful way to understand ODPA is to consider the polymer as a complete monomer pair:

ODPA-derived structure + diamine-derived structure → repeating polyimide architecture

The dianhydride is only one side of that relationship.

If ODPA is paired with different diamines, the resulting polymers can have different chain geometries, intermolecular interactions, morphologies and material properties.

Research illustrates this clearly.

ODPA has been used with 4,4'-diaminodiphenyl ether, or ODA, to produce polyimide films. It has also been combined with 2,2'-dimethyl-4,4'-diaminobiphenyl, or DMB, in polyimide fiber research. These systems share the same ODPA dianhydride but do not represent the same polymer architecture.

This leads to an important engineering principle:

there is no single universal property set that can accurately describe every “ODPA-based polyimide.”

The term identifies one structural component of the polymer. It does not define the complete material.

Why the Ether Linkage in ODPA Matters The ether linkage is one of the main reasons ODPA is technically distinct from more rigid aromatic dianhydrides.

Molecular Rigidity and Mobility High-performance polymer design does not always mean maximizing

molecular rigidity.

A highly rigid backbone may support certain thermal or dimensional characteristics, but it also restricts molecular motion. Depending on the polymer system, that can affect morphology, solubility, film formation and processing behavior.

The ether oxygen in ODPA changes the rotational freedom between the aromatic structural units.

The molecule still retains substantial aromatic character, but its architecture is not equivalent to a fully rigid, directly connected aromatic dianhydride.

This distinction provides polymer chemists with another variable when designing the balance between backbone rigidity and chain mobility.

Chain Packing and Molecular Organization Once incorporated into a polymer, molecular geometry can influence how neighboring chains approach and organize.

Relevant material characteristics can include:

intermolecular packing; chain orientation; crystallinity in systems capable of developing ordered regions; amorphous morphology; molecular mobility. These effects cannot be assigned to ODPA in isolation.

For example, research on ODPA-DMB polyimide fibers found that crystallinity and orientation depended strongly on drawing conditions. The researchers also observed that ultimate tensile behavior was related to molecular orientation and the structure developed during fiber processing.

The result demonstrates why chemical structure and processing history need to be considered together. **Why This Matters in Material Design** The purpose of using ODPA is therefore not to guarantee one specific polymer property.

Its value is that it provides a distinct ether-linked aromatic dianhydride architecture.

Polymer scientists can combine that architecture with different diamines and processing approaches to develop materials with different balances of:

rigidity; molecular mobility; morphology; mechanical response; dielectric characteristics; thermal behavior; processability. The appropriate balance depends on the intended material system.

How Diamine Selection Changes an ODPA-Based Polyimide The diamine paired with ODPA is one of the most important variables in determining the resulting polymer structure.

ODPA with 4,4'-ODA One relevant example is the ODPA-ODA polyimide system.

4,4'-ODA is itself an aromatic diamine containing an ether linkage. When ODPA and ODA are used together, both monomers contribute ether-containing aromatic structural units to the polymer architecture.

An RSC Advances study used ODPA and ODA to prepare porous polyimide films and investigated how film morphology affected dielectric behavior. The work demonstrates that ODPA-ODA is a real polyimide monomer combination, while also showing that the measured dielectric performance belonged to the engineered film system rather than to either monomer individually.

Another study used ODPA as the dianhydride together with ODA and sulfur-containing SDA diamines to prepare copolyimide films. Changing the diamine composition changed dielectric, mechanical and corona-aging behavior.

These results illustrate a broader point:

keeping ODPA constant does not keep the finished polymer properties constant.

ODPA with Other Aromatic Diamines ODPA has also been studied with more rigid aromatic diamine structures.

In ODPA-DMB polyimide fibers, crystallinity, molecular orientation and tensile behavior were strongly linked to drawing and annealing history.

This matters for material evaluation because chemical composition establishes the possible polymer architecture, while processing determines how that architecture is organized in the final material.

Diamine selection and material processing therefore cannot be separated from an assessment of an ODPA-based polyimide.

What Properties Are Actually Evaluated in ODPA-Based Polyimides? The properties that matter depend

on the finished material and intended use.

They should not be confused with the basic physical properties of the ODPa monomer.

Thermal Behavior Researchers may evaluate parameters such as:

glass-transition behavior; thermal-degradation behavior; thermo-oxidative stability; dimensional response at elevated temperature. These values belong to the polymer system.

A melting point reported for the ODPa raw material, for example, does not define the service temperature of a polyimide produced from ODPa.

Mechanical Properties Polyimide films and fibers may be evaluated for:

tensile strength; modulus; elongation; resistance to mechanical deformation. ODPa-DMB fiber research demonstrates that mechanical performance can be strongly influenced by molecular orientation and crystallization produced during processing.

This is why a monomer name alone cannot predict finished mechanical properties.

Electrical and Dielectric Behavior ODPa-based polyimide systems are also studied for electrical and dielectric characteristics.

The ODPa-ODA-SDA film study, for example, investigated how molecular composition affected dielectric loss and corona resistance. Different diamine compositions produced different results even though ODPa remained part of the system.

Likewise, porous ODPa-ODA films have been investigated for low-dielectric behavior, with film morphology deliberately modified during material preparation.

These results belong to the specific films tested.

They should not be converted into statements such as “ODPa has a low dielectric constant.”

Morphology and Processing Characteristics Material researchers may also examine:

film morphology; chain orientation; crystallinity; amorphous organization; film-forming characteristics; processing response. These characteristics help explain why two materials with related chemical compositions may still show different finished properties.

ODPa in High-Performance Polyimide Films Starsky Chemical currently positions its ODPa product specifically as a raw material for polyimide material preparation. The product page does not claim that every grade or batch is automatically qualified for a particular electronic, dielectric or high-temperature film application.

The broader research literature nevertheless provides useful technical context for understanding how ODPa can participate in film systems.

ODPa-ODA has been used to prepare porous polyimide films whose morphology and dielectric characteristics were studied systematically.

ODPa has also been used in ODPa-ODA-SDA copolyimide films developed for research into dielectric properties and corona-aging performance.

These examples show that ODPa can serve as a dianhydride building block in different film architectures.

They do not establish one universal performance specification for commercial ODPa.

For industrial qualification, the appropriate question is whether a defined ODPa-containing formulation meets the thermal, mechanical, electrical and processing requirements of the intended film.

ODPa in Polyimide Fibers and Structural Polymer Systems Polyimide fiber research provides another useful example of the relationship between monomer chemistry and finished-material structure.

ODPa-DMB polyimide fibers have been studied to understand how drawing and annealing affect crystallinity, molecular orientation and tensile properties. The work found that draw ratio strongly influenced both crystalline organization and overall chain orientation.

The importance of this study is not that ODPa guarantees a particular fiber strength.

The more useful lesson is that an ODPa-derived polymer architecture can develop very different material structures depending on how the polymer is processed.

This same principle applies more broadly to films and other engineered polymer forms:

monomer selection establishes the molecular architecture, while material processing helps determine

how that architecture is expressed in the finished product.

Why ODPa Is Not Simply “Better” Than Other Dianhydrides Polyimide chemistry includes many aromatic dianhydrides, including structures based on PMDA, BPDA, BTDA, 6FDA and ODPa.

They differ in characteristics such as:

molecular rigidity; symmetry; linkage type; steric structure; polarity; conformational freedom. These differences mean that the choice of dianhydride should be based on the targeted polymer architecture rather than a simple ranking.

ODPa should therefore not be described as universally better than a more rigid dianhydride.

Its defining value is more specific:

ODPa introduces an aromatic dianhydride structure containing an ether linkage.

That architecture provides a different balance of rigidity and molecular mobility, which may be useful in particular polyimide designs.

Whether it is the appropriate choice depends on the diamine and the performance requirements of the finished material.

What Should Engineers Consider When Evaluating ODPa Raw Material? Starsky Chemical currently publishes the following main specifications for its ODPa product:

Property Starsky Chemical Published Specification **Product** 4,4'-Oxydiphthalic Anhydride **Abbreviation**

ODPa **CAS Number** 1823-59-2 **Molecular Formula** C₁₆H₆O₇ **Molecular Weight** 310.21

g/mol **Appearance** White powder **Purity** ≥99% **Melting Point** 225–229 °C These values provide a starting point for raw-material evaluation.

Exact Chemical Identity The CAS number is particularly important because different oxydiphthalic anhydride structures should not be assumed to be interchangeable.

Material specifications should identify the exact chemical rather than relying only on a shortened family name.

Purity Starsky Chemical currently specifies ≥99% purity for its ODPa listing.

Purity is relevant to polymer monomers, but a single percentage does not describe every aspect of raw-material quality.

For demanding polymer systems, technical users may also need to consider the analytical method and impurity profile according to their own validated requirements.

Batch Consistency A material that performs acceptably in initial laboratory screening must also be evaluated for repeatability when a polymer formulation moves toward repeated production.

Batch-to-batch consistency can therefore be as important as an individual assay result.

Analytical Documentation Technical qualification should ultimately be based on the documentation and actual material supplied for a project.

A public product specification is useful for preliminary evaluation, but it does not replace the customer's own incoming-material criteria or polymer-specific validation.

Why Raw-Material Quality Matters in High-Molecular-Weight Polyimides Polymer monomers are evaluated differently from finished engineering materials.

For a dianhydride such as ODPa, raw-material assessment may involve:

exact identity; purity; impurity profile; isomer control where relevant; consistency between batches; analytical documentation; application-specific acceptance criteria. A headline specification such as ≥99% purity is important, but it should be interpreted within the needs of the polymer system being developed.

High-molecular-weight polymer chemistry can be sensitive to monomer quality and stoichiometric control. For that reason, researchers and manufacturers generally need repeatable raw-material characteristics when comparing polymer batches or transferring a formulation from development to regular production.

The Starsky Chemical product specification can therefore serve as an initial qualification reference, while final acceptance should remain based on the user's validated material requirements.

Safety and Regulatory Considerations ODPa is an industrial chemical and should be evaluated within an

appropriate chemical-safety framework.

Application information about polyimides does not replace a current Safety Data Sheet, workplace risk assessment or applicable regulatory requirements.

Organizations using ODPA should base their occupational controls, storage assessment and regulatory review on the current SDS for the supplied material together with their internal EHS procedures.

Material-performance information and chemical-safety information answer different questions. Both need to be considered during industrial qualification.

FAQWhat is ODPA used for in polyimide materials?ODPA is used as an aromatic dianhydride monomer. Its dianhydride-derived structure becomes part of the polyimide backbone when it is combined with an appropriate diamine. Starsky Chemical's current product page identifies polyimide material preparation as the main application of its ODPA product.

Why is ODPA considered relevant to high-performance polyimide design?ODPA combines aromatic structural units with an ether linkage and two anhydride functionalities. This provides a distinct backbone-building architecture that polymer scientists can combine with different diamines to obtain different balances of rigidity, molecular mobility and material behavior.

What does the ether linkage in ODPA contribute?The ether linkage changes the conformational freedom between the aromatic units. It therefore contributes to the balance between aromatic backbone rigidity and molecular mobility. The final effect depends on the complete polymer structure.

Does ODPA determine the heat resistance of a polyimide?No. Thermal behavior is a property of the finished polymer system. It depends on the dianhydride, diamine, molecular architecture, morphology and processing history. ODPA contributes one structural unit but does not define a universal service temperature.

Can ODPA be used with 4,4'-ODA?Yes. ODPA-ODA is an established polyimide combination in published research. It has been used, for example, in studies of porous polyimide films.

Can ODPA be used with different aromatic diamines?Yes. ODPA has been investigated with different diamines. ODPA-DMB polyimide fibers and ODPA-ODA-SDA copolyimide films are two examples showing how changing the diamine structure and composition can produce different polymer architectures and material behavior.

Is ODPA better than PMDA or BPDA?Not universally. ODPA, PMDA, BPDA and other dianhydrides provide different molecular architectures. The appropriate choice depends on the diamine, processing route and the balance of thermal, mechanical, electrical and dimensional properties required from the finished polymer.

ODPA is therefore most accurately evaluated as one structurally distinct dianhydride option within a complete polyimide design, rather than as a monomer that is automatically superior to every alternative.

Media Contact

Shanghai Starsky New Material Co., Ltd.

*****@starskychemical.com

+86 13162192651

<http://starskychemical.com>

Source : Shanghai Starsky New Material Co., Ltd.

[See on IssueWire](#)