



## Pasquick® Polyaspartic Technology – Change the Coatings Game

Desmodur® Desmophen®







Desmodur® Desmophen

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## Covestro – leading in material solutions

As the world's leading manufacturer of aliphatic and aromatic polyisocyanates, Covestro offers an extensive range of innovative products and solutions for the coatings and adhesives industries. As your customers become more demanding in their expectations for the quality, durability, workability and sustainability of your products, we can help you to turn these challenges into a competitive advantage. That is what drives us to push the boundaries of what is possible.

The key to creating added value for you, our customers, as well as for society and the environment is innovation. At Covestro, we innovate not only to address the key global challenges of population growth, urbanization, climate change, digitalization and increasing mobility; we innovate to have a sustainable business that enables us to live up to our business purpose of "making the world a brighter place." In the final analysis, this comes down to developing sustainable solutions that take the entire life cycle of a product into account. We are increasing our on-site efficiency, e.g., by recycling salt and water in our production plants. We are expanding our resource base, e.g., by turning CO<sub>2</sub> into a raw material in the manufacturing of plastics. And we are developing materials that are more energy-efficient and save natural resources.

In our Coatings, Adhesives, Specialties (CAS) segment, we systematically develop and supply aliphatic and aromatic isocyanates and their derivatives as well as polyurethane dispersions. Our raw materials are used for coatings, adhesives, sealants and specialty products, such as elastomers, high-quality films, 3D printing products, cosmetics, textiles and medical products. The main application areas are in the automotive, transportation, infrastructure, construction, wood processing and furniture industries. In this segment, our innovative efforts are focusing on enhancing efficiency, improving quality, boosting sustainability and environmental aspects such as reducing solvent content.

We are proud of over 80 years of groundbreaking innovations. But we are not defined by our past. Even with decades of experience behind us, Covestro remains a young enterprise. In a corporate world that can often be dull and uninspiring, we want to act in a curious, courageous, and colorful way: trying out new things, questioning established ways, and pushing boundaries – for your benefit.





## What we do

As a world-leading polymer and material science company, we inspire innovation and drive growth through profitable products and technologies that benefit society and reduce the impact on the environment.

## Who does all this?

It's our people! And the way we work together as one global team following a set of six elementary principles – value creation, sustainability, innovation, focus on people, safety, and fair play. This is our formula for success.

# What this means for our Coatings, Adhesives and Specialties business

## Quality & supply security

Our products are of outstanding quality and we offer supply security – worldwide.

Covestro, the world's leading manufacturer of aliphatic and aromatic polyisocyanates, offers an extensive range of raw materials and services for the coatings and adhesives industry. This allows the very latest technology to be used extremely effectively for a variety of applications.

Our global setup enables you to increase your competitive advantage.

### What we offer:

- A global network of research & development centers where our staff are dedicated to offering solutions for the coatings and adhesives industry.
- A unique setup and worldwide network of state-of-the-art production sites ensuring short lead times and supply chain flexibility.
- Outstanding product quality through fulfilling the requirements of state-of-the-art quality, environmental and safety (HSEQ) as well as energy management standards; we are proud of having enjoyed ISO 9001, ISO 14001, ISO 18001 and ISO 50001 certifications for many years.

Covestro is your reliable partner for polyurethane chemistry.

## Solutions to enhance your process efficiency

Nowadays, the quality demands made on industrial processes are very high. This is equally true of the cost-cutting requirements. However, both goals can be achieved by increasing process efficiency. At Covestro, we have a wide range of solutions designed to enhance your process efficiency. Why not take advantage of our know-how? These solutions will benefit your bottom line.

## Sustainability

Sustainability is at the heart of the Covestro strategy. We inspire innovation and drive growth through profitable products and technologies that benefit society and reduce the impact on the environment.

Our coatings, adhesives and specialty products and solutions contribute to sustainabilities through:

### • Saving energy – fast and smart

Polyurethane systems represent a benchmark in productivity and process efficiency in many industries. We strive to further push the limits of efficiency by developing game-changing new solutions.

### • Reducing waste

We offer solutions such as innovative 1K technologies that enable our value chain partners to use materials more efficiently and reduce waste.

### • Cutting emissions

Bayhydur® and Desmodur® grades are key enablers for low-emission solutions in the coatings and adhesives industries – waterborne and high solids/solvent-free!

### • Responsible management of natural resources

Highly durable PU-based coatings and adhesives significantly extend the lifetime of a coated product and thus help to prolong resource use.

### • Closing the loop (circularity)

Through economically viable products made from bio-based raw materials – with no deterioration in performance – we help our customers and value chain partners to reduce their carbon footprint and offer solutions that incorporate renewable building blocks.

# Pasquick® polyaspartic technology – the game-changing benefits

Pasquick® is the brand name for the polyaspartic technology from Covestro.

Nowadays, machine manufacturers, owners of commercial or industrial premises, car refinishing shops and other relevant decision-makers want coatings that can speed up the painting operation while at the same time deliver the high performance known from 2K PUR coatings. Without sacrificing performance, Pasquick® polyaspartic coating technology offers greater productivity for applications in car refinishing, construction, protective and industrial coatings. Whether for cars, rail vehicles, bridges, stadiums, large buildings, flooring or architectural elements, Pasquick® technology brings cost savings in application and enables normal operation to be resumed in the shortest possible time. That is why Pasquick® polyaspartic technology can indeed change the coatings game.

## Increased productivity and cost efficiency

The main benefit of Pasquick®-based coatings is that they significantly increase productivity in the application process. This gain in productivity over conventional coating technologies can be achieved thanks to two properties of polyaspartic coatings:

- Significantly faster drying times at ambient temperature than conventional 2K PUR coatings, which allows a faster return to service or earlier handling of the coated parts.
- For high film build applications, a much greater film thickness in a single operation is possible, which in practice means one layer can be saved.

This increased efficiency is particularly important in a chain of operations where the coating process can often act as a bottleneck. The two benefits of rapid drying and reduced number of coats significantly boost productivity.

## Energy costs and CO<sub>2</sub> savings

The unique reactivity of aspartics with aliphatic polyisocyanates makes their reaction kinetics more independent of temperature than is the case with conventional 2K coating technologies. In practice, that means that no oven is required to obtain fast cure properties.

Especially in high-throughput paint shops for car refinishing or in railway paint shops, Pasquick® polyaspartic coatings contribute significantly to reducing energy costs and CO<sub>2</sub> emissions – both factors of increasing importance.

## From ultra-high solids to 100% solids

Increasingly strict legislation demanding reductions in volatile organic solvents necessitates the use of low-solvent coating materials. In the case of OEM coatings for plant and machinery this is particularly relevant when conventional coating materials have to be replaced. However, many low-solvent or 100% solids coating materials require an investment in new equipment and/or modifications to the production process. Since this is often impossible or simply too expensive, coating materials that can be used with existing equipment are of particular interest. Low-solvent coating materials, which (depending on the application) either have a VOC content of less than 250 g/l or are virtually solvent-free in their ready-to-use state, can be produced on a polyaspartics basis to comply with current legislative requirements, e.g., the EU VOC Directive.





### Long-lasting performance

In general, the well-known positive attributes of aliphatic 2K polyurethane coatings are also found in 2K Pasquick®-based coatings, e.g., high gloss retention during weathering, adjustable flexibility through the polyisocyanate chosen, resistance to acids and alkali, high mechanical resistance (e.g., abrasion resistance and impact strength) and ease of repair. The key benefits that determine the success of Pasquick® coatings are illustrated here:



Fig. 1: Key benefits in the success of polyaspartic coatings





# Pasquick® polyaspartic technology

## Pasquick® for industrial coatings/corrosion protection

Thanks to their high productivity, polyaspartics are already being used for a variety of metal coatings. One of the main applications is the OEM coating of steel parts for corrosion protection and industrial coating purposes.

### Industrial coatings

In the field of industrial coatings, Pasquick® technology is widely used for coating agricultural and construction machinery. The size and weight of such machines mean they are often unsuitable

for forced drying at elevated temperatures. The two-coat system frequently used at present for such machines can be replaced by a one-coat polyaspartic topcoat.

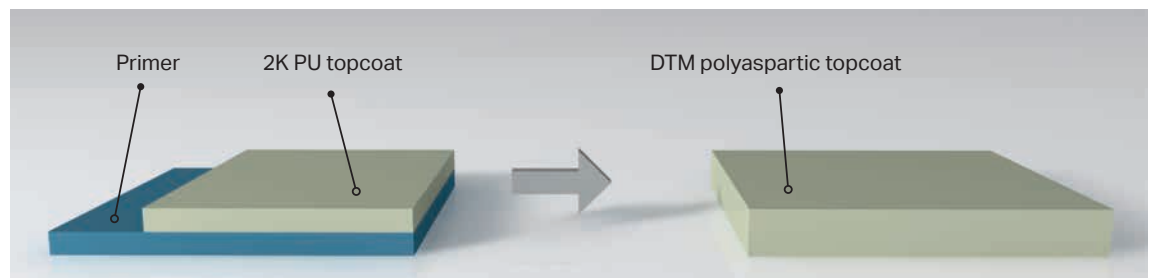


Fig. 2: Replacement of the primer by a direct-to-metal polyaspartic topcoat

### Corrosion protection

In the case of the three coats frequently applied for heavy-duty corrosion protection, e.g., on bridges and wind turbines, the intermediate coat can be replaced by a Pasquick® topcoat (see figure below).

The main applications for Pasquick® topcoats are in the field of OEM coatings. Numerous practical examples in the past have demonstrated the suitability of Pasquick® technology for heavy-duty corrosion protection.

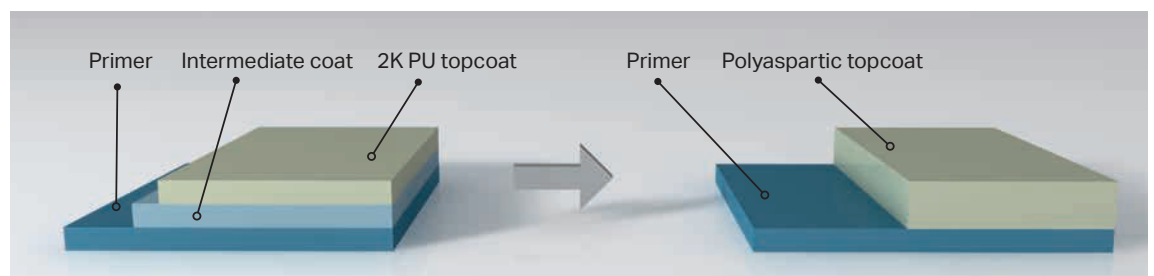


Fig. 3: Replacement of the intermediate coat by a polyaspartic topcoat



#### **Coating systems and leading edge protection for wind turbine blades**

Wind turbines have to withstand extremely rugged conditions over long periods of time. For several years now, Pasquick®-based gel coats, pore fillers, putties, primers and pigmented top coats have been used for coating rotor blades made of glass fiber-reinforced composites to prolong the working lives of wind turbines. These reactive 2K systems can be applied by rolling, brushing, knifing or spray-coating, even at high film thicknesses. They are used to fill pores, smooth the surface, and protect the rotor blades against weathering. To prevent rain erosion, special coatings for leading edge protection (LEP) have been developed. The great efficiency of these polyaspartic systems means that an entire paint system can be applied in a single working day thanks to the high film thickness, fast drying/curing, and early sandability. Through the unique combination of high flexibility and hardness, these systems display good adhesion to the substrate and protect the rotor blades against atmospheric exposure, such as UV light and rain, to ensure long working lives for wind turbines.

#### **Pasquick® for automotive refinish and transportation coatings**

In a world of increasing mobility and a rapidly growing number of vehicles on the road, accidents happen. When they happen, whether a car needs a little touch up or a complete overhaul, polyaspartic systems for automotive refinish coatings and a professional application will make it look like new again. The high competitive pressure in the automotive repair business drives the industry's efforts towards a continuous improvement of the painting process. For manufacturers of repair coating systems who are looking for throughput improvements in the whole repair process, polyaspartic-based systems offer substantial savings in both cycle times and energy consumption while fulfilling the end users' high quality requirements. Furthermore, these systems make a bodyshop's workflow more flexible, because they enable fast drying by oven curing, infrared, or even at ambient temperatures. Additionally, rail vehicle manufacturers benefit from cost and energy savings thanks to Pasquick®-based very fast ambient curing systems.



- **Clear coats:** Very high solid clear coats based on aspartics and reactive thinners in combination with special low viscosity polyisocyanates offer the benefits of very fast drying times at ambient temperatures, good chemical resistance and a highly brilliant finish that reduces the time and effort needed for polishing.
- **Primer surfacers:** Combinations of polyaspartics with reactive thinners (aldimines), low-viscosity polyisocyanates, and a minimum amount of solvent for spray application are used to formulate very high-solid primer surfacers or fillers (VOC < 250 g/l). Such systems are characterized by rapid dry sandability, good adhesion to a wide range of metal substrates, and excellent corrosion protection.
- **Knifing putty:** Low-odor knifing putties based on highly reactive polyaspartics and low-viscosity polyisocyanates can be formulated for a quick repair process and offer the benefits of easy application, rapid dry sandability, and good adhesion to metal.

By using a repair coating system based on Pasquik® polyaspartic technology, it is possible not only to reduce solvent content and save up to 80% of energy costs, but also to make the whole repair process far more efficient, resulting in a significant increase in throughput.

Desmophen® NH-based refinish coating systems are essentially speed in a can!

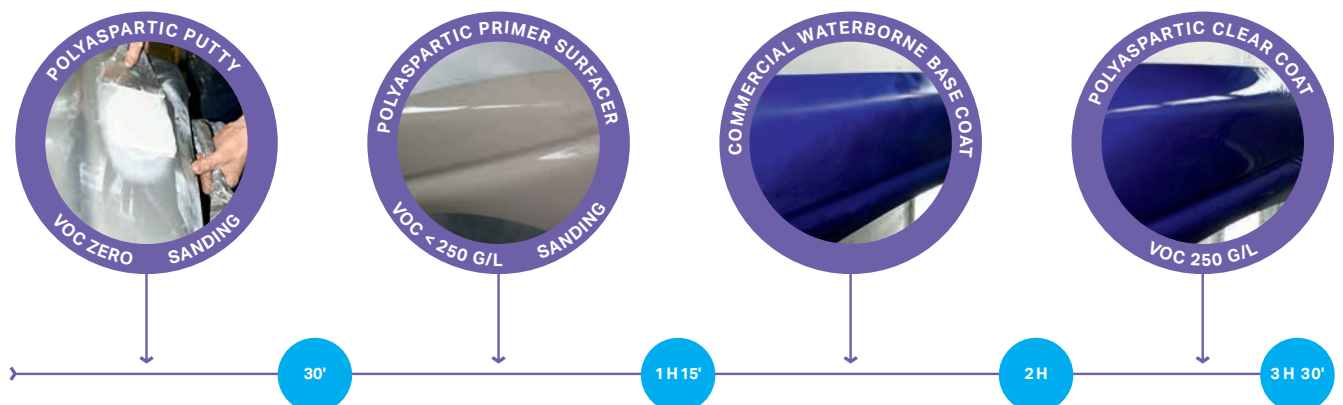
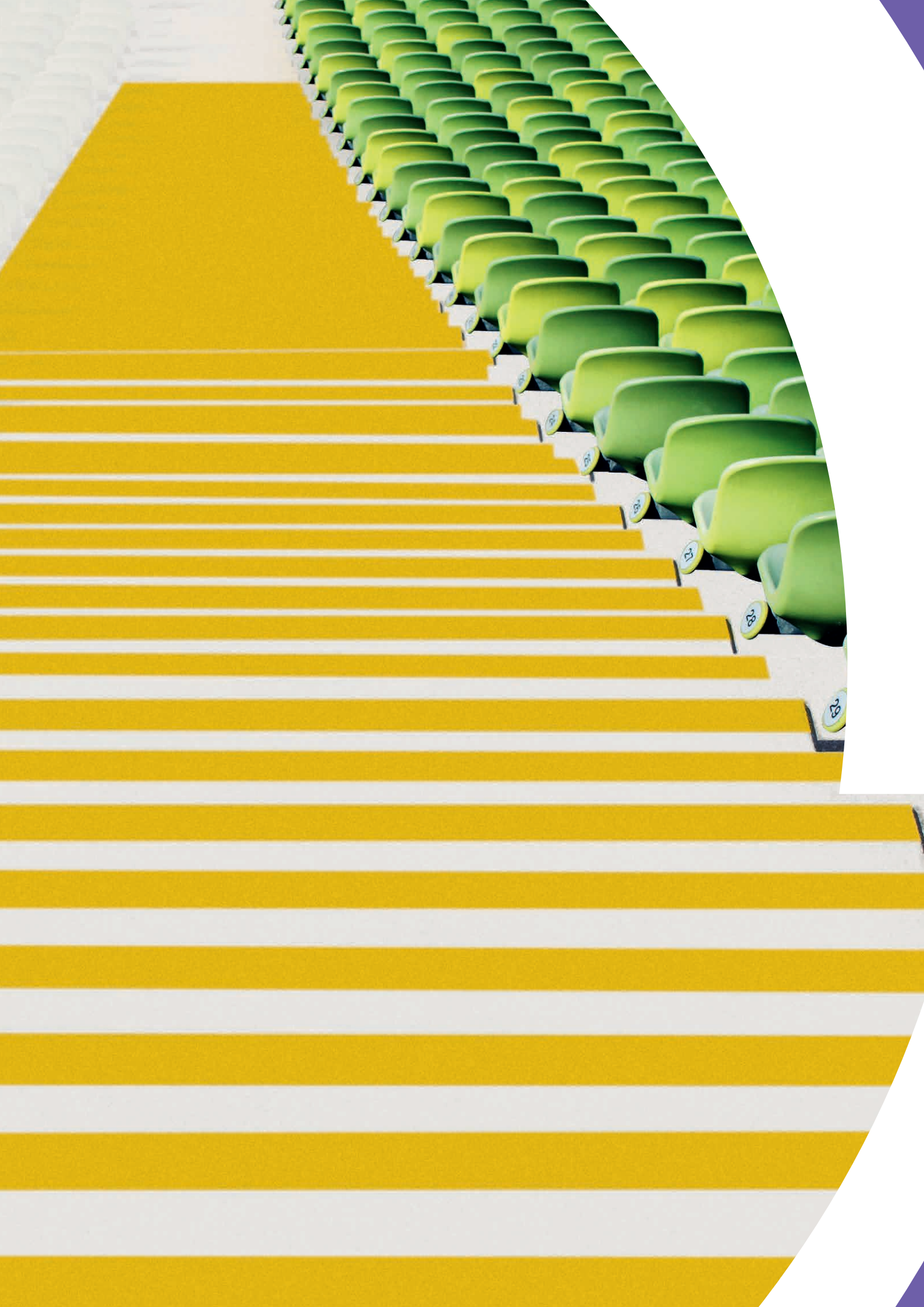


Fig. 4: Efficiency of polyaspartic systems for automotive and large vehicle repairs

ROOM TEMPERATURE, 50% RH





### Construction industry

In the construction industry, polyaspartic coatings have long been in use in many application areas, such as topcoats (e.g., for polyurea, self-leveling floor coatings, parking decks or garages), stone carpets (e.g., as a binder for colored sand, decorative mortars or terrazzo), waterproofing (e.g., balcony, terrace or access balconies) or sealants (pourable joint sealants). Each field of application has its own individual requirements, which can be met with the wide range of formulation possibilities offered by our Pasquick® technology toolbox. Furthermore, our technology allows formulations that fulfill the demanding requirements of indoor air regulations (AgBB). What they all have in common is the need for speed to allow normal work to be resumed as quickly as possible, making project and cost efficiency possible without compromising longevity.

### Topcoats

- **Polyurea self-leveling floor coats and parking decks:** Most common floor coatings are based on aromatics (= yellowing binders). Standard 2K polyurethane topcoat technology can add color

stability to the system but with a curing time of approx. 8–16 hours, the application no longer enjoys the advantage of weather tolerance. Polyaspartic coatings are a logical supplement to fast-setting polyurea technology. When applied by roller or 1K airless spray equipment, a polyaspartic topcoat allows a 2-hour curing time with a pot life of approx. 30 min. Consequently, the complete waterproof coating system is virtually weather-independent.

- **Fast-setting garage coating system:**

Painting small areas like a private garage (up to 150 m<sup>2</sup>) using a conventional coating system is a time-consuming and labor-intensive business. A curing time of between 8–16 hours with the common solvent-borne 2K technology means that contractors can only apply one coat per day and have to come to the site at least three times. With polyaspartic coating technology, a 3-coat system can be applied with a roller within a day, saving significant labor costs and hassle for the owner. In addition, ultra-low VOC and indoor air quality compliant polyaspartics coating systems are now state of the art (see figure below).

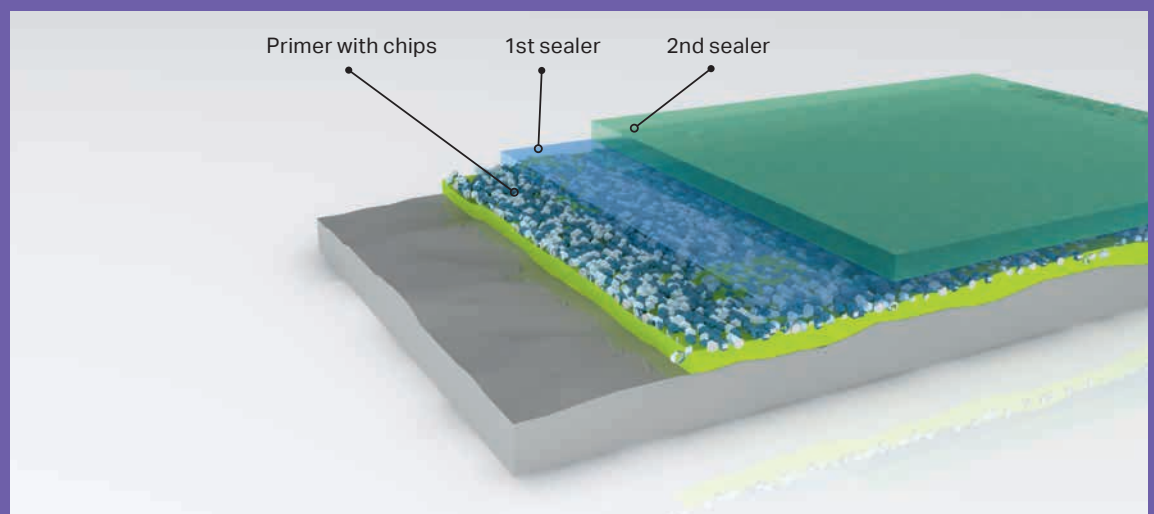
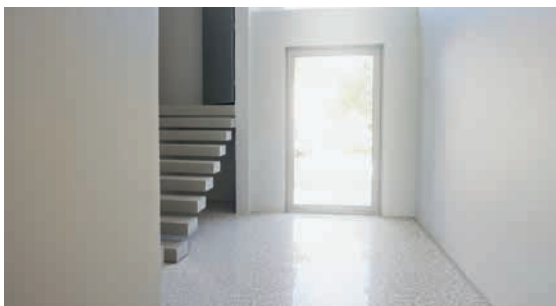


Fig. 5: Fast-setting garage coating system



- Highly decorative photo flooring:** In the past, laying highly decorative seamless flooring was a big job requiring a great deal of time-consuming preparation followed by artistic painting with many small paint cans and brushes. Since 2–4 m<sup>2</sup>/h for the actual picture was normal, an entire floor could take 5–7 days, even for small shop-in-shop areas. But now polyaspartic coating photo floor technology has introduced a kind of “pre-fab” work routine to the world of floor coatings. The floor picture is printed on fabric and applied in a lamination process on site. Normal working can resume on the decorative flooring within 8h so that a shop owner, for example, will have the work done overnight.
- Concrete sealers for stamped and/or stained concrete:** Stamped and/or stained concrete can be protected against soiling and given greater abrasion resistance by a clear coat. Conventional sealers are solvent-based or, in the case of waterborne 1K paints, no longer comply with requirements such as durability, abrasion, etc. Polyaspartic clear coats not only provide long-lasting performance, they are also ultra-low VOC and indoor air quality-compliant, making them the first choice for indoor applications.
- Stone carpet binders:** Seamless stone carpets are another decorative flooring alternative. Mosaic or terrazzo-like decorative flooring can be produced through a mixture of natural stones or colored quartz sand (for which polyaspartics can also be used) and a reactive binder. The fast-curing properties and brilliance of polyaspartic coatings are a major advantage in this field.







### **Decorative waterproofing for outdoor applications**

Balconies, roof gardens, loggias and access balconies are exposed to sunlight and weathering. What's more, they are often subject to significant mechanical stresses. Flexible decorative polyaspartic waterproofing membranes are the product of choice as they can be formulated as 100% solids and fast-drying coatings. The resulting membranes are lightfast and resistant to moisture, display moderate chemical resistance properties, and have crack-bridging properties to prevent water penetrating into the building, even at low temperatures.

### **Pourable joint sealants**

Pourable joint sealants based on polyaspartic technology offer some unique advantages over other technologies. By choosing the right products, the UV and color stability of the sealant can be dramatically improved. Polyaspartic joint seal-

ants also have the unique ability of curing at low temperatures. In addition, the use of plasticizers can be eliminated in some formulations. Apart from their good working-to-curing time ratio, polyaspartic sealants, once cured, offer better physical properties than conventional pourable sealants.

### **In tune with market drivers**

Concerted efforts to enhance effectiveness and efficiency are more important than ever while the quality and environmental compatibility of coatings remain crucial success factors. Polyaspartic coatings are fully in tune with these market drivers, with their use in different industrial and construction applications demonstrating the key benefits polyaspartic coatings bring. So it is hardly surprising that they are now being used in more and more fields of application, e.g., in-mold coatings.



# Polyaspartics chemistry – and our portfolio

Aspartics are sterically hindered secondary diamines (see figure below).

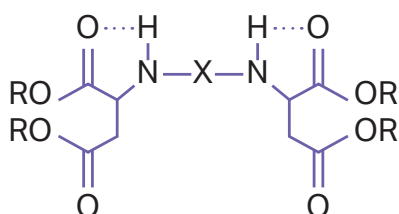


Fig. 6: General structure of aspartics

## General structure of aspartics

The reactivity of aspartics with polyisocyanates can be influenced through the choice of the rest X (see fig. left), which enables the parameters of pot life and drying time to be specifically adjusted in a broad range (see the table below).

Our aspartics portfolio	SUPPLY FORM SOLID CONTENT [%]	AMINE NUMBER APPROX. [mgKOH/g]	VISCOSITY AT 25°C [mPa · s]	EQUIVALENT WEIGHT APPROX.	COMMENTS
<b>Desmophen® NH 1220</b>	100	244	90	234	High reactive binder or co-resin for fast-setting very high solids to 100% solids 2K PU coatings (putty elastomers, spray-applied aliphatic polyurea).
<b>Desmophen® NH 1420</b>	100	201	1,450	276	Standard, moderate reactive Pasquick® resin or co-resin for very high solids to 100% solids 2K PU coatings (floor coatings, corrosion protection topcoats, ACE & commercial vehicles, general industrial coatings), indoor air quality-compliant.
<b>Desmophen® NH 1422</b>	100	201	1,450	276	A Desmophen® NH 1420 type with prolonged pot life.
<b>Desmophen® NH 1423</b>	100	206	1,500	272	Performance similar to NH 1420 with better gloss retention and improved industrial hygiene.
<b>Desmophen® NH 2850 XP</b>	100	190	100	295	Reactive diluent for very high solids to 100% solids 2K PU coatings (floor coatings, corrosion protection topcoats, ACE & commercial vehicles, general industrial coatings), indoor air quality-compliant.
<b>Desmophen® NH 1520</b>	100	191	1,400	290	Low-reactive Pasquick® resin or co-resin for very high solids to 100% solids 2K PU coatings (corrosion protection topcoats).
<b>Desmophen® NH 1521</b>	90 BA	172	160	326	90% supply form of Desmophen NH 1520.

Aspartics react with aliphatic polyisocyanates to form polyaspartics (see figure below).

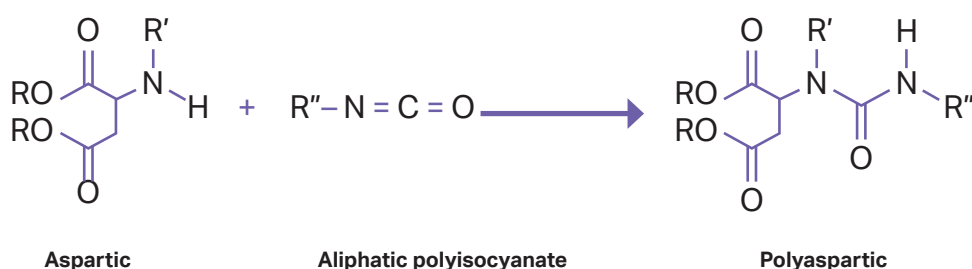


Fig. 7: Reaction of aspartics with aliphatic polyisocyanate to give polyaspartics



The choice of polyisocyanate, which depends on the factors, influences the properties of the polyaspartics:

- Desired VOC content
- Application
- Mechanical properties
- Adhesion to the substrate

Aliphatic polyisocyanates as co-reactants for aspartics	SUPPLY FORM	NCO CONTENT		FUNCTIONALITY		COMMENTS
	APPROX. [%]	ON SUPPLY FORM	APPROX. [%]	APPROX.	APPROX.	
		VISCOSITY AT 23°C APPROX. [mPa · s]		EQUIVALENT WEIGHT APPROX.		
<b>Desmodur® N 100</b>	100	10,000	22.0	190	3.8	Basic Pasquick® coatings hardener for solvent-borne, weather-stable and non-yellowing topcoats.
<b>Desmodur® N 75 MPA/X</b>	75 MPA/X	250	16.5	255	3.8	Special supply forms of Desmodur® N 100 for different applications; other supply forms available.
<b>Desmodur® N 75 MPA</b>	75 MPA	280	16.5	255	3.8	
<b>Desmodur® N 75 BA</b>	75 BA	160	16.5	255	3.8	
<b>Desmodur® N 3200</b>	100	2,500	23.0	185	3.5	Lower viscosity than Desmodur® N 100.
<b>Desmodur® ultra N 3600</b>	100	1,200	23.0	185	3.2	Low-viscosity crosslinker for lightfast coatings; standard hardener for Pasquick® coatings.
<b>Desmodur N 3790</b>	90 BA	1,800	17.8	235	4.1	Best compromise to realize early resistance and high appearance for refinish clearcoats based on polyaspartics.
<b>Desmodur® N 3800</b>	100	6,000	11.0	380	3.8	Pasquick® coatings hardener to improve impact resistance and deliver moderate flexibility.
<b>Desmodur® N 3900</b>	100	730	23.5	180	3.2	Low-viscosity crosslinker for Pasquick® coatings (very high solids to near-zero VOC), especially for floor coatings.
<b>Desmodur® XP 2763</b>	80 BA	2,100	10.2	412	3.0	Crosslinker for Pasquick® coatings; longer pot life and extended application window; reduced dependency on humidity with Pasquick® coatings.
<b>Desmodur® XP 2840</b>	100	500	23.0	185	3.0	Low-viscosity crosslinker for Pasquick® coatings (very high solids to near-zero VOC), especially for floor coatings.
<b>Desmodur® XP 2860</b>	100	500	20.0	215	2.5	Low-viscosity crosslinker for Pasquick® coatings (very high solids to near-zero VOC), especially for floor coatings; very good combination of working and short curing time; preferred hardener for fast-setting 2K spray coatings.
<b>Desmodur® E 2863 XP</b>	100	1,350	11.0	380	2.2	Low-viscosity, highly flexible crosslinker for Pasquick® coatings, e.g., waterproofing membranes, flexible floor coatings, leading edge protection.

The wide variety of possible combinations enables the development of customized polyaspartic-based coating materials to meet a wide range of requirements.





## Fast-lane access to polyurethane innovations

At Covestro, innovation is in our DNA. Ever since Otto Bayer discovered polyurethanes in 1937, we have been driving polyurethane innovations in coatings and adhesives as well as in other application areas. As our partner, you enjoy fast-lane access to polyurethane innovations, and can help us in developing the next generation of polyurethanes to meet the industry's upcoming challenges and needs. What can we offer you?

- Powerful know-how on both established and new polyisocyanates, as well as on new polyurethane hybrid technologies
- The prospect of new application technologies to enable efficient processes
- More sustainable, biomass- or CO<sub>2</sub>-based materials that do not sacrifice high performance

**Join us to shape the future!**





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