Improved Tribology and Reduced Wear

Quality Assured
Ionbond coating centers hold ISO 9001/9002, and numerous industry-specific certifications and supplier approvals from a number of world-leading companies in many industries. Ionbond constantly works on improving its offerings to enhance the performance and lower the unit cost of coated products.

Many machines and machine parts benefit from the use of wear-resistant and low-friction coatings in order to increase the efficiency and to assure longevity.

In some situations coatings are the enabling elements to make designs, higher mechanical and thermal loads and material combinations possible. Ionbond has been providing engineered solutions into many industries for over 40 years and has built up a broad application know-how base to serve each individual customer request at best.

Lubricated contacts
Tribobond™ coatings are often used in dry or low lubrication conditions. However, the coatings show improved conditions in lubricated contacts as well. The diagram shows the advantage of coated vs. uncoated components from dry start to full lubricated operation.

- Boundary and mixed mode: Tribobond™ offers lower friction and protects from galling
- Elasto-hydrodynamic mode: Tribobond™ increases load-bearing capacity and acts like an oil additive

In many applications Tribobond™ coatings also act as a safety measure in case of loss of lubrication in order to avoid major damage before emergency stop.
Advantages across all Industrial Applications

**Hard Chrome Replacement**
Hard chrome is increasingly being replaced with PVD films
- Environmentally friendly
- No post-coating machining
- Lower coefficient of friction
- Increased hardness

**Food and Pharmaceuticals**
Many ingredients used for food and pharmaceutical products are abrasive, tend to stick and must not come in contact with lubricants.
- Food- and bio-compatible
- Greaseless mechanical assemblies

**Heavy Duty Machines and Vehicles**
Conditions for earth moving, mining, agricultural machines and military vehicles are subject to the harshest conditions of dirt, dust, humidity and temperatures.
- Reduction of 3 body and abrasive wear
- Increased reliability

**Power Generation**
Extended uptimes, shorter maintenance breaks, efficiency of wind mills and turbines.
- Corrosion protection
- Less friction losses

**Transportation**
Higher efficiency and lower emission requirements demand downsized and higher power-density motors.
- Increased load capacity on precision components
- Higher power density

**Corrosive and Erosive Environment**
Tribobond™ coated stainless steels and nickel alloy components are ideal for corrosive environments.
- No fretting and galling
- Protection from erosion

**General Engineering**
Be it a pump, a bearing, a set of gears or a hydraulic unit, Tribobond™ enhances the life span of sliding and rolling surfaces and helps reducing the input for more output.
- Reduced lubrication
- New material pairings
Surface Engineering is more than a Coating

**Dry Lubrication**

Many applications require very tight control or do not allow the use of lubricants. Oils and greases can be heavily reduced or avoided by the use of Tribobond™ coatings. Parts can be used unlubricated due to the very low coefficient of friction, < 0.1 enabling the uncoated mating part to also be protected against wear. If both contact surfaces are coated the friction and the wear rate can be reduced still further.

- Coefficient of friction < 0.1
- Bio- and food-certified materials
- No particle generation

**Friction table**

<table>
<thead>
<tr>
<th>Material</th>
<th>COF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>0.74</td>
</tr>
<tr>
<td>Chrome</td>
<td>0.50</td>
</tr>
<tr>
<td>Bronze</td>
<td>0.22</td>
</tr>
<tr>
<td>PTFE</td>
<td>0.10</td>
</tr>
<tr>
<td>DLC</td>
<td>0.04</td>
</tr>
<tr>
<td>DLC</td>
<td>0.05</td>
</tr>
</tbody>
</table>

**Pre- and Posttreatment**

To achieve optimal performance, Ionbond employs a number of pre- and post-coating surface treatment technologies specifically developed in conjunction with coatings in order to take full advantage of the improved performance that coatings offer.

**Duplex Coatings**

In situations where additional corrosion protection or added hardness of the substrate is required an electroplated underlayer of nickel is used. This underlayer also acts as a leveling element for a smooth surface.
# Industrial Coatings Overview

<table>
<thead>
<tr>
<th>Technology</th>
<th>PVD Nitrides</th>
<th>PVD Carbon-based</th>
<th>PVD / PACVD</th>
<th>CVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coatings</td>
<td>Tribobond™</td>
<td>Tribobond™</td>
<td>Tribobond™</td>
<td>Bemex™</td>
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<tr>
<td></td>
<td>01 TiN</td>
<td>40 Cr+a–C:H:W</td>
<td>41 Cr+a–C:H:W+a-C:H,</td>
<td>01 TiN</td>
</tr>
<tr>
<td></td>
<td>15 TiAlCrN</td>
<td>44 a–C:Cr</td>
<td>42 CrN+a-C:H,</td>
<td>08 Ti(B,C,N)</td>
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<tr>
<td></td>
<td>20 TiAlN</td>
<td>45 Cr+a–C</td>
<td>43 (Cr+) a–C:H,</td>
<td>10 TiCN</td>
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<tr>
<td></td>
<td>30 CrN</td>
<td>46 CrN+a–C:H:W</td>
<td>47 CrN+a–C:Cr+a–C:H</td>
<td>29 Al2O3</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>48 Cr+ta–C</td>
<td>66 Al</td>
</tr>
<tr>
<td>Typical Coating Thickness [µm]</td>
<td>2 to 10</td>
<td>2 to 5</td>
<td>2 to 5</td>
<td>5 to 50</td>
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<tr>
<td>Cross Sections</td>
<td><img src="image" alt="Cross Sections" /></td>
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<td><img src="image" alt="Cross Sections" /></td>
<td><img src="image" alt="Cross Sections" /></td>
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<tr>
<td>Deposition T [°C]</td>
<td>150–450</td>
<td>120–200</td>
<td>120–200</td>
<td>800–1000</td>
</tr>
<tr>
<td>Service T [°C]</td>
<td>400–900</td>
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<td>250</td>
<td>400–1000</td>
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<tr>
<td>Friction vs. Steel</td>
<td>0.4–0.8</td>
<td>0.1–0.3</td>
<td>&lt; 0.1</td>
<td>0.2–0.6</td>
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<tr>
<td>Microhardness HV0.05</td>
<td>2000–3500</td>
<td>1200–5000</td>
<td>1200–2800</td>
<td>2000–4000</td>
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</table>

### Wear Mechanisms

<table>
<thead>
<tr>
<th>Wear Mechanism</th>
<th>PVD Nitrides</th>
<th>PVD Carbon-based</th>
<th>PVD / PACVD</th>
<th>CVD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fatigue (Impact)</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
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<tr>
<td>Adhesive (Galling/Scuffing)</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔</td>
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<tr>
<td>Abrasive</td>
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<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
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<tr>
<td>Fretting</td>
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<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td>Erosion</td>
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<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
<tr>
<td>Oxidation</td>
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<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
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<tr>
<td>Inner Diameters</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
<td>✔ ✔ ✔ ✔ ✔ ✔</td>
<td>✔ ✔ ✔</td>
</tr>
</tbody>
</table>

For a complete coating listing please see [www.ionbond.com](http://www.ionbond.com)
Competence and Innovation – Worldwide

Ionbond is a leader in surface enhancement technology and provides advanced coating solutions featuring a broad range of hard, low friction, wear resistant coatings based on PVD, PACVD and CVD technologies for a wide range of applications. It has a global presence with coating centers in strategic locations across Europe, Asia, and North America and has one of the largest coating networks in the world.

Ionbond is part of the IHI Group, a Japanese industrial group with significant R&D resources that operates through multiple business fields including: Energy and Resources, Social Infrastructure, Industrial Machinery and Aero Engines.

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