EDITORIAL

Dear Customer,

In this present issue of the Equipment News, I have the privilege of presenting our Equipment Segment Product Management team. Our daily work as an equipment manufacturer does not only consist of constructing and assembling new coating systems and machines.

Day by day, our development engineers are working on new structures and compositions for the next generation of coatings. In the first section of this issue, I can provide a short glimpse into this world of constant further development and our Product Management team with its newest developments and products.

Based on the close collaboration between our coatings development team and our equipment engineering team, we are able to introduce new equipment components and processes to the market on a regular basis. As a matter of fact, Ionbond has invested a lot in product development in the recent years. As a result, our production facility in Olten, Switzerland, has a brand new R&D CVD coating system at its disposal, equipped with the latest components available today. This guarantees thorough testing in real application scenarios and ensures product safety and quality requirements.

I am particularly pleased that I am able to present the latest products and developments in this issue. This includes a new process furnace and a completely new approach to pressure regulation.

Finally, I would like to announce that Ionbond will be present at this year’s GrindTec 2016 show in Augsburg, Germany. We kindly invite you to visit us at our booth, discuss the latest equipment news and get to know us more personally.

With kind regards,

Christian Behlinger
Head Customer Service
The newest version of the pressure regulation valve can be installed on any Bemex™ CVD system. It is constructed entirely of metal parts and specialized sealings in order to master not only the most demanding process regulation conditions but also to withstand the most corrosive atmospheres of various process gases.

- Design according to the latest CE and ATEX regulations
- Faster, more precise and reliable regulation behavior between 3 and 800 mbar
- Simple setup mode
- Longer maintenance intervals
- Allows for higher operating temperatures

The regulation valve can be used under a wide range of temperatures (up to 400 °C), based on the respective process requirements. Its construction allows for cleaning with hot-water, which reduces the need of regular maintenance.

Depending on the process pressure and flow range, the valve can be subsequently configured without the need for replacement.

Due to the short shaft design and the resulting fast response behavior, the pressure regulation valve is highly compatible and recommended for use in combination with Ionbond’s “Low Pressure System”. Especially in reactor pressure ranges below 10 mbar, the regulation valve responds far more precise and not only assists in achieving the desired pressure ranges more reliably, but also maintains the pressure in a more consistent manner.

The pressure regulation valve can be configured and customized (mechanically and electronically) to your specific needs and process requirements.
**AICl$_3$ GENERATOR XXL (90KG)**

The new AICl$_3$ Generator with larger capacity extends the operational capability of a standard CVD system by a time factor of 2.5. This can be achieved without the need to refill Al- pellets or any other maintenance activities.

- Increased production time (> 250%)
- Reduced Cost of Ownership
- Reduced system downtime
- Identical implementation (100% AICl$_3$) efficiency compared to traditional 35kg model

An additional step forward is the redesign of the cooling trap, which now allows for longer or more activation sequences and further use without the need of opening and cleaning. This improvement has the additional advantage on the operational side by consequently decreasing the cost-of-ownership of the entire equipment.

The vastly improved insulation material offers a significant enhancement of energy management and temperature control.

Furthermore, the supporting mechanism allows an easy handling and accessibility into the generator during emptying and refilling.
NEW TEMPERATURE CONTROL SYSTEM

The new furnace offers an improved solution for heating-up and provides greater temperature stability. In addition, the new design reduces the heating-up time compared to the previous model. The improved energy uniformity is reflected in homogeneous coating growth rates as well as absolute thickness, which is now restricted to a +/-10% deviation from a respective average value.

The new design increases the average lifetime of the furnace by approximately 300%. In case a heating zone is defective, it can be replaced on the premises with minimum effort and without the need to disassemble the entire furnace. As a result, the downtime of the furnace is minimized by half.

- Greater power density based on new coil design - max. temperature 1100 °C
- 10% reduced heating-up times at the same power capacity
- Larger power/wire surface area, increased lifetime (+300%)
- Optimized temperature distribution, improved coating thickness distribution
- Simplified replacement of heating elements

Reactor temperature distribution with new furnace (left) and traditional furnace (right)
**CVD α-Al₂O₃ COATING LAYER**

The history of depositing Al₂O₃ layers through CVD is not entirely new, but started in the 1980s. Since then, no other CVD coating has been under such intensive further development.

The constantly increasing demands to longer lifetimes of the tools, faster machining process times, and less scrap have no doubt led to this continuous development.

Properties of α-Al₂O₃:

- α-Al₂O₃ cannot be oxidized; it is a natural oxide (Corundum)
- The hardness is classified as 9 Mohs [1] (equivalent to 2100HV); second hardest mineral in nature after diamond (10 Mohs)
- The hardness and Young modulus exhibit rather exceptional values at elevated temperatures (up to 1100 °C)
- The low thermal conductivity of α-Al₂O₃ protects any tungsten carbide tool against further heat-up and undesirable oxidation
- Extremely high density, given the low molar weight

Cross section of latest α-Al₂O₃ Bernex™ coating

The further developed α-Al₂O₃ layer provides high machining performance with well-balanced properties for various applications that require high wear resistance and elevated cutting speeds. In the example shown in the graph below, the latest coating’s turning performance as function of insert’s flank wear is compared to its predecessor. The graph nicely demonstrates that the lifetime of the insert is increased by a minimum of 50%.

The latest Ionbond CVD technology not only allows for the conventional targeted shifting of Al₂O₃ phases (between alpha and kappa), but also its crystal orientation in an ordered way, which improves the thermal conductivity, the mechanical properties and, consequently, the lifetime of the coated tool.

Finally, the new α-Al₂O₃ layer exhibits vastly improved adherence properties, which overcomes the major drawback of previous versions of the coating.

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1 - [http://www.minsocam.org/msa/collectors_corner/article/mohs.htm](http://www.minsocam.org/msa/collectors_corner/article/mohs.htm) (10.03.2016)
The development of new and more efficient wear resistant coating is motivated by increasing demands on cutting tools which result from the increase of high-speed and dry cutting processes as well as the cutting of hard materials.

Such materials include austenitic stainless steels and cast materials as well as high-strength alloys for automotive and aircraft engineering. In applications like these, high cutting speeds are necessary and temperatures of more than 1000 °C are expected on the cutting edge.

Over the last decades, Ti$_{1-x}$Al$_x$N with face center cubic (fcc) structure has become an important standard layer for wear resistant applications. Ionbond has developed a new industrial scale CVD technology for the deposition of high aluminum containing Ti$_{1-x}$Al$_x$N coatings with stoichiometry coefficient up to $x = 0.91$ and face centered cubic structure. The cubic Ti$_{1-x}$Al$_x$N phase, however, can only be produced in a certain process window, such as temperatures below 850 °C, low pressures and using certain ratios of Al/Ti. At temperatures above 850 °C, TiN and AlN are co-deposited. High contents of these secondary phases are not desired, as hardness, oxidation resistance and wear resistance of the layer are reduced.

Aluminum chlorides AlCl$_3$ and Titanium Chlorides TiCl$_4$ are used as starting materials. For this purpose, TiCl$_4$ liquid is evaporated and AlCl$_3$ is generated in-situ before introducing it into the CVD reactor. An additional novelty here is the use of Ammonia NH$_3$ as Nitrogen source. Hence, Ionbond developed a special NH$_3$ module with an optimized gas mixing and distribution system and a specific tool loading procedure in order to make the process viable on an industrial scale. The last process characteristic is the low pressure conditions that are required and favor the formation of cubic Ti$_{1-x}$Al$_x$N. For this purpose, Ionbond has developed a special low pressure pumping system (LPS) for the CVD equipment that allows the operation at pressures below 10 mbar.

The example to the left shows a Ti$_{1-x}$Al$_x$N coating with a high aluminum content of $x = 0.83$ which consists of a cubic phase “fcc-TiAIN”. This layer also demonstrates high fcc-TiAIN hardness values of approx. 29 GPa at room temperature and moderate residual compressive stress up to -2 GPa.
A SNEAK PEAK INTO...

THE PRODUCT MANAGEMENT - CVD DEVELOPMENT

Our focus at Ionbond is to provide both high quality standard coating portfolios for the cutting, molding and forming tool market and to offer customized solutions for our customers making OEM components.

Ionbond is eager to tackle difficult and specialized challenges and to put in the time and energy required to meet custom equipment and coating requirements. We work with our customers in very close cooperation to perform regular reviews of the equipment performance and reliability (also with respect to improvements in the field of spare parts) and ensure the coatings meet all the critical requirements. We keep experiencing during such cooperations how important and pleasant is to successfully accomplish common working projects. Consequently, Ionbond works intensively not only by designing the most versatile coating equipment for various markets and applications and offering state-of-the-art CVD coatings but also continuously improving existing equipment to be able to produce a large variety of coatings for numerous highly demanding applications.

In my function as Product Manager CVD, I have the great pleasure of introducing you to the synergistic concept of CVD Equipment and Coatings, which makes Ionbond absolutely exceptional in this technological field. Some of the latest coating developments presented in this issue of the Equipment News were made possible exclusively with the support of various newly developed components. These components not only improve the reliability and handling of the coating equipment, but also provide additional value to the end product.

Our CVD competence center in Switzerland consists, among others, of four highly experienced CVD process engineers, including myself. With the endless support of the entire engineering department as well as our production facilities, we work exclusively on both discovering the advantages of additional hardware components as well as on developing or improving existing coatings based on the latest market trends. At this point, I would like to extend a big Thank You to my colleagues and fellow team members for their enormous efforts they have invested in realizing the breakthroughs presented in this newsletter.

Vasileios Papageorgiou
Product Manager CVD

CVD Product Management Team

Hristo Strakov
Head Product Engineering

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TRADE FAIR INFORMATION

Ionbond at GrindTec 2016 in Augsburg

GrindTec 2016
International Trade Fair for Grinding Technology
16 - 19 March · Messe Augsburg · Germany

Hall 2 / Booth 2183

From March 16 to 19 2016, we will be at GrindTec 2016 Trade Fair in Augsburg, Germany, and we will present our newest developments and products.

We are looking forward to your visit.
Competence and innovation – worldwide

Ionbond is a global leader in surface enhancement technology and has been dedicated to serving high-demanding industries such as tool making, automotive, industrial, aerospace, racing, medical and many others with its coating equipment for the past 40 years. This has enabled a deep understanding of the materials requirements and future trends facing these industries.

Ionbond also has a global presence with coating centres in strategic locations ready to work in partnership with manufacturers and their suppliers to provide cost-effective solutions to the most pressing needs facing the industry.

With ISO 9001 and specific certifications for individual industries and numerous manufacturer approvals Ionbond is the partner for equipment as well as coating services.