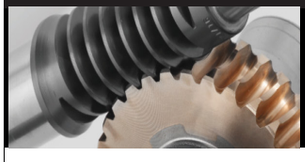
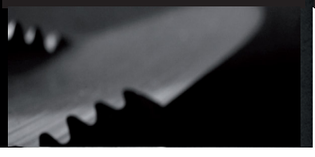
Multi®



Mec®



Tool®

HP®

Luxury®

ARGOR-ALJBA

DLC Coatings

SWISS MADE

EN

Foreword

The focus of Argor-Aljba is the production and the development of high-tech coatings. The successful launch of the two coating lines dianoir® and dialong®, represented an important breakthrough of its market activity. The result of its decade of scientific research within the realm of extremely thin and high performance coatings is a unique patented filtered arc PVD process for the deposition of DLC coatings (Diamond-Like-Coating). It's a solution for industrial and aesthetical applications of exceptional hardness within the field of DLC-Coatings and is employed to protect surfaces from wear and to reduce friction.
Today, Argor-Aljba is a fast growing company, serving the high demand for innovative new coatings for different industries and numerous applications.

The customer benefit in the industry

Continuing increase in productivity, higher flexibility and the pressure to reduce create a strong demand on producers, machine tool builders as well as tool manufacturers to search for improvements of geometries, materials and innovative coatings.
The application of dialong® as a coating solution of processing tools for non-ferrous materials is a possibility to hold the pace with this development.
The reduction of lubrication solvents, wear protection or saving of material come to the fore in many mechanical applications. Be it gearbox construction parts, fuel injectors (injection nozzle) or parts of watch movements – the use of dialong® grants wear parts a much longer lifetime.
This leads to higher availability of the system.

Our solution for watches and jewelry

Highest aesthetical requirements combined with superior properties regarding scratch and wear resistance: the black-anthracite dianoir® coating meets already today all pre- conditions for the application on products of first-class Swiss watch and jewelry manufacturers.
After years of experience and with the support of our specialists, we can assist customers in selecting the best coating solution for its specific application.
Please refer to our website about the latest developments in the rapidly evolving nanotechnology.

DLC-Coatings

Argor-Aljba's two product lines are Diamond-Like Carbon (DLC) Coatings that are based on pure carbon. Due to their tetrahedral structure they acquire the properties of a diamond. The share of the sp3-configured carbon lies around 75–85%, which is the reason for the high content of diamond structure. Furthermore, due to its procedure, Argor-Aljba's coatings are completely free of hydrogen. The thereby obtained structure endows the coatings with the following properties:

- Extreme hardness of about 7000 HV (twice as hard as other DLC layers)
- Utmost wear resistance (around two times compared to other DLC layers)
- Very low friction coefficient
- Perfect adherence, thanks to a special intermediate layer
- Humidity resistant
- 100% biological compatibility
- Chemical stability and corrosion resistance

Through their properties Argor-Aljba coatings clearly stand out compared to conventional coatings: considerably reduced friction and extreme hardness, the performance and life span of tools and components are increased by many times as well.

Type of Coating		Micro hardness (HV)	Friction coefficient	Max. Temperature of depositon [°C]	Typical processed materials
Argor-Aljba DLC ta-C dialong® dianoir®	ta-C	5'300	0.08-0.12	<100	Alluminium and copper alloys, precious metals, plastic composites and graphite
Titanium Nitride	TiN	2'300	0.40	<500	Steel, stainless steel
Titan-Aluminium Nitride	TiAlN	3'000	0.35	<500	Steel, stainless steel
Chrom Nitride	CrN	1'800	0.50	<500	Copper
Zirconium Nitride	ZrN	2'500	0.45	<500	Copper and titanium

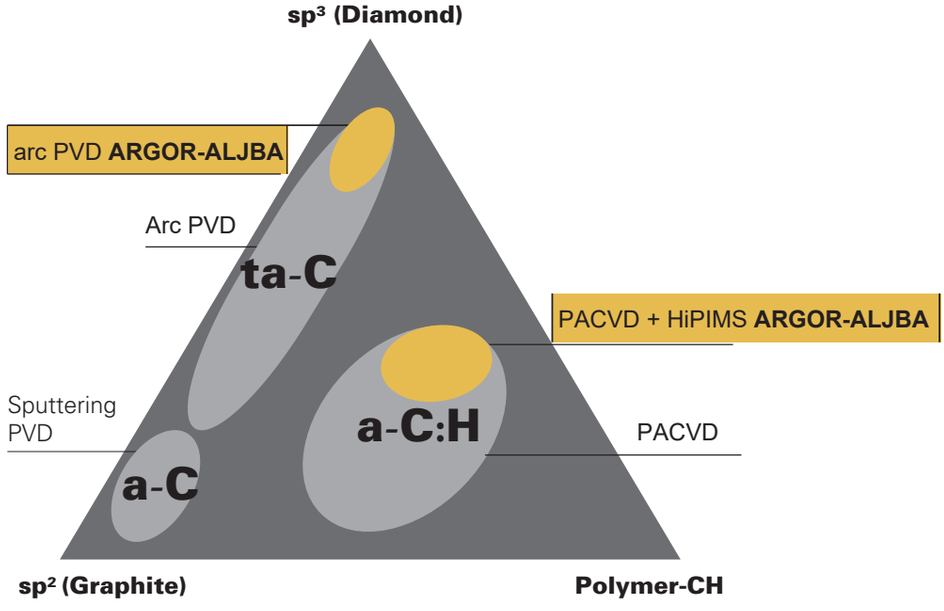
Background Information on Diamond-Like-Carbon (DLC)

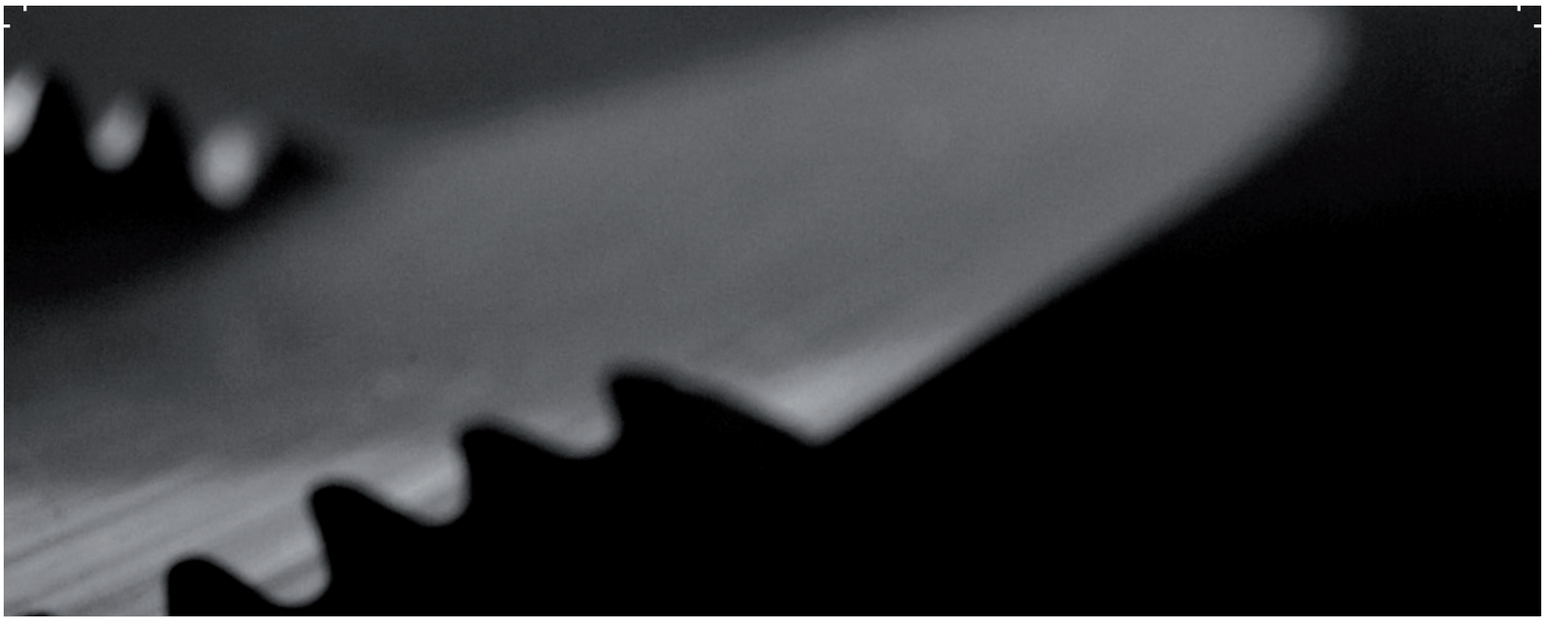
The following pyramid explains the different forms of appearance of graphite and therefore also its properties in the world of coatings:

sp2: configured carbon is a black and very soft material. The greater the quotas of this form of carbon, the softer the layer. This combination is usually found amongst the amorphous carbon layers produced with the conventional sputter process.

Polymer-CH: Through the CVD process, hydrogen is incorporated into the carbon layer. However, this reduces the hardness of the layer and entails very low application temperatures.

sp3: configured carbon is pure diamond – famous for its extreme hardness. Layers produced through the Argor-Aljba arc PVD process possess a great proportion of diamond structure and are therefore particularly hard. The remaining residual portion of graphite improves the gliding properties of the layer: The optimal solution in the domain of carbon layers with almost unlimited application possibilities.



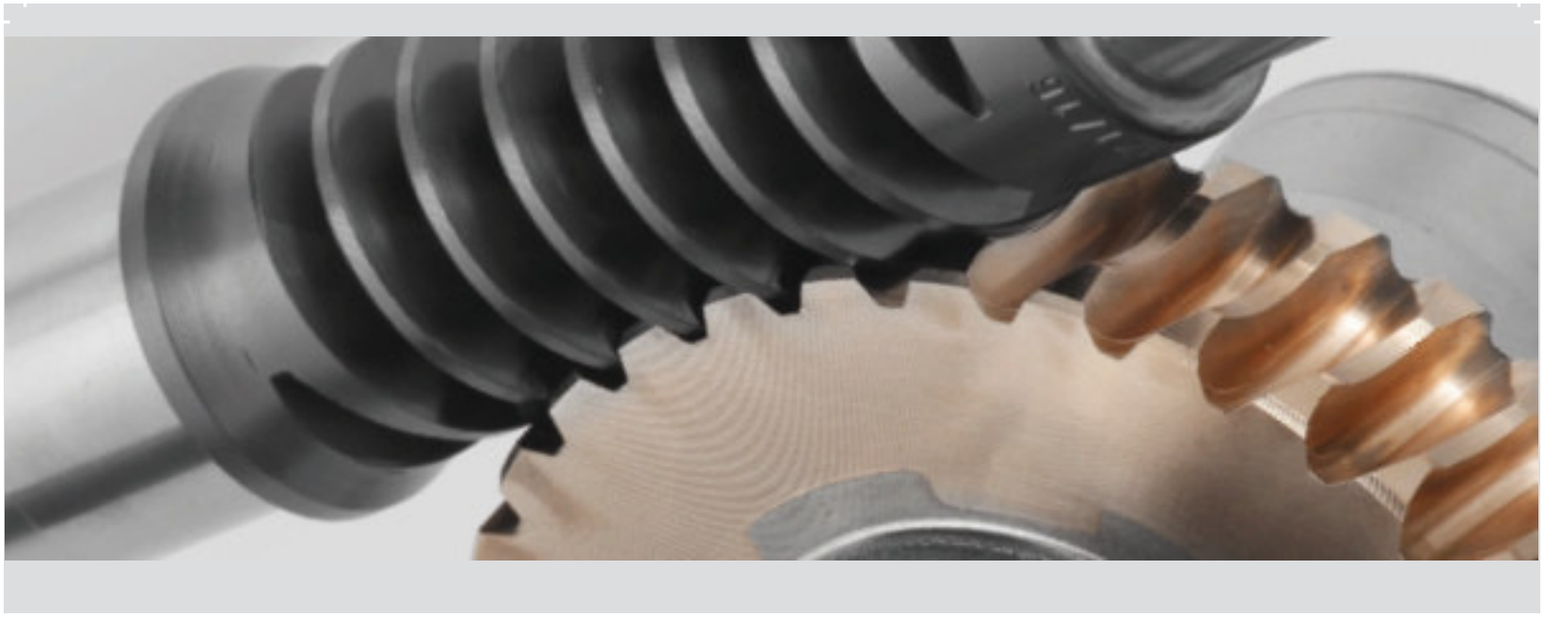


Products coated with Argor-Aljba technology offer superior properties compared to conventional DLC coatings

Argor MULTI

Type of coating	Argor WCC	Nitrocarbo
VDI abbreviation	WC/C	CrN + WC/C
Process	PACVD	PACVD
Composition (C:H)		
Structure		
sp3 fraction [%]		
Temperature of deposition [°C]	<200	<200
Color	anthracite	anthracite
Thickness [µm]	1-4	2-5
Density [g/cm3]		
Max. operating temperature [°C]	300	300
Transparency [µm]		
Hardness [GPa]	14	19
Hardness HV 0.05	1500	2000
Adhesion	++++	++++
Biocompatibility *		
Friction coefficient **	0.08	0.08
Electric resistivity [µΩcm]		
Applications	Decreases the coefficient of friction in conditions of poor lubrication	WC/C on CrN base to increase the resistance under load of mechanical components
Protection against adhesive wear	++++	++++
Protection against abrasive wear	++	+++

+, ++, +++, ++++ Functional properties (increasing)
* The biocompatibility has to be verified by the customer for its specific application
** Friction coefficient, dry against carbide (at 50% humidity)



Products coated with Argor-Aljba technology offer superior properties compared to conventional DLC coatings

Argor MEC

Type of coating	Argor a-C	Argor aDLC	dropless® aDLC
VDI abbreviation	a-C	a-C:H	a-C:H +ta-C
Process	PVD Sputtering	PACVD	PACVD+Arc
Composition (C:H)	100:0	70:30	80:20
Structure	amorphous	amorphous	amorfphous
sp3 fraction [%]	25-40	40-60	50-90
Temperature of deposition [°C]	<120	190	190
Color	black	black	black-grey
Thickness [µm]	1-2	2-3	2-3
Density [g/cm3]	1.8-2.5	1.8-2.0	2.3 / 3
Max. operating temperature [°C]	450	400	400
Transparency [µm]	0.3	0.5	0.5
Hardness [GPa]	9-14	19-24	38
Hardness HV 0.05	1000-1500	2000-2500	4000
Adhesion	+++	++++	++++
Biocompatibility *	+++	+++	+++
Friction coefficient **	0.15	0.12	0.08
Electric resistivity [µΩcm]	$10\text{-}10^{7}$	$10^{7}\text{-}10^{10}$	$10^{7}\text{-}10^{9}$
Applications	Technical and engine components	Technical and engine components	Technical components and for high performance engines
Protection against adhesive wear	++++	++++	++++
Protection against abrasive wear		++	++

Products coated with Argor-Aljba technology offer superior properties compared to conventional DLC coatings

Argor TOOL

Type of coating	Carbo	Carbo S	Carbo Plus
VDI abbreviation	ta-C	ta-C	ta-C
Process	PVD Arc	PVD Arc	PVD Arc
Composition (C:H)	100:0	100:0	100:0
Structure	amorphous	amorphous	amorphous
sp3 fraction [%]	75	75	75
Temperature of deposition [°C]	<100	<100	<100
Color	rainbow	rainbow	grey
Thickness [µm]	<0.5	<0.5	<1
Density [g/cm3]	2.8	2.9-3.0	2.9-3.0
Max. operating temperature [°C]	500	500	500
Transparency [µm]	0.7-1	0.7-1	0.7-1
Hardness [GPa]	38	48	53
Hardness HV 0.05	4000	5000	5500
Adhesion	++++	++++	++++
Biocompatibility *	+++	+++	++++
Friction coefficient **	0.1	0.1	0.1
Electric resistivity [µΩcm]	10^7-10^{10}	10^7-10^9	10^7-10^9
Applications	Cutting tools Machine components	Cutting tools Machine components	Cutting tools Machine components
Protection against adhesive wear	++++	++++	++++
Protection against abrasive wear	++	++	++

Products coated with Argor-Aljba technology offer superior properties compared to conventional DLC coatings

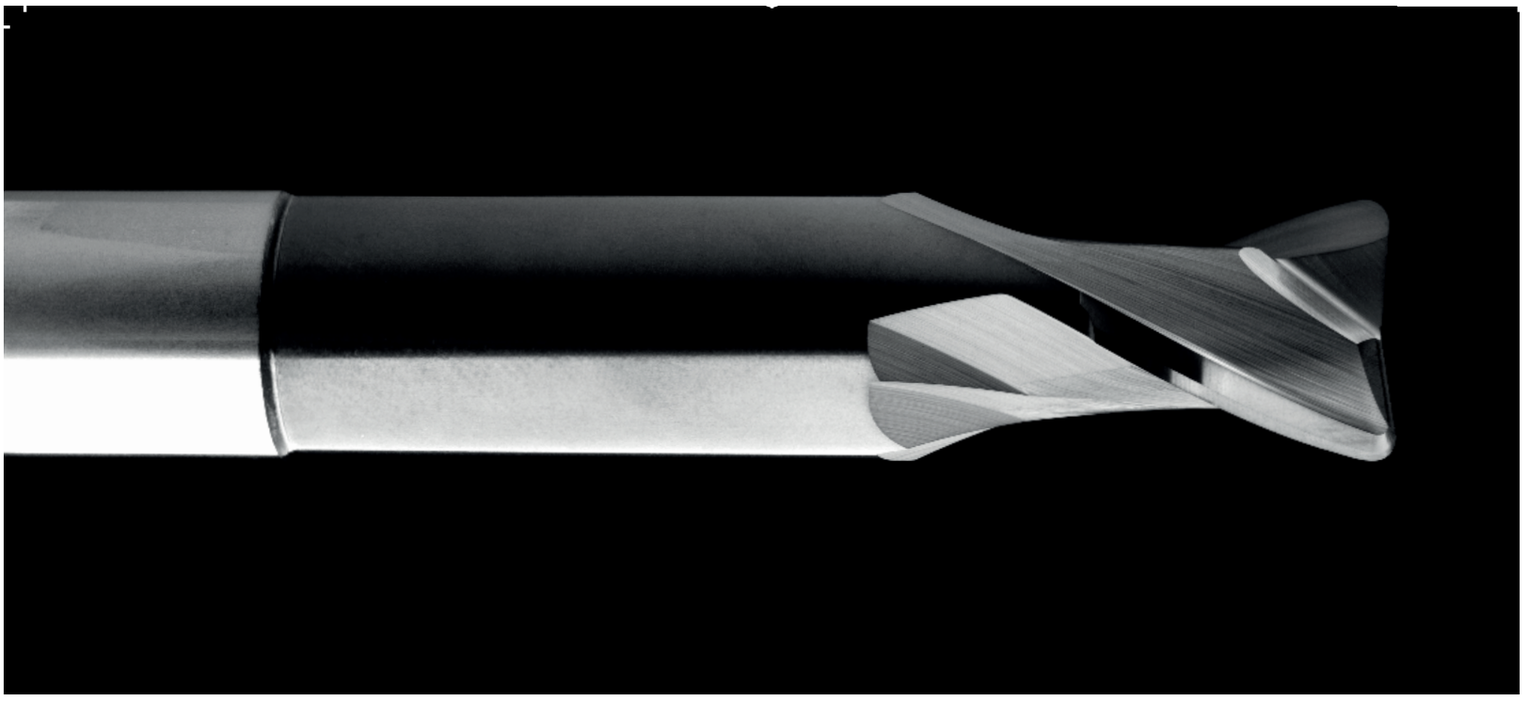
Argor HP

Type of coating	dialong®	dropless® 5000	dropless® 5000 Plus	dropless® 7000
VDI abbreviation	ta-C	ta-C	ta-C	ta-C
Process	PVD Arc	PVD Arc	PVD Arc	PVD Arc
Composition (C:H)	100:0	100:0	100:0	100:0
Structure	amorphous	amorphous	amorphous	amorphous
sp3 fraction [%]	75	85	85	85
Temperature of deposition [°C]	<100	<100	<100	<100
Color	black-grey	rainbow	black	rainbow
Thickness [µm]	1	0.5	1	0.5
Density [g/cm3]	2.9-3.0	3.1	3.1	3.1
Max. operating temperature [°C]	500	500	500	500
Transparency [µm]	0.5-0.7	0.7-1	0.7-1	0.7-1
Hardness [GPa]	52	48	48	68
Hardness HV 0.05	5300	5000	5000	7000
Adhesion	++++	+++	+++	+++
Biocompatibility *	++++	++++	++++	++++
Friction coefficient **	0.1	0.1	0.1	0.1
Electric resistivity [µΩcm]	10^7-10^9	10^9-10^{11}	10^9-10^{11}	10^9-10^{11}
Applications	Cutting tools Machine components	Moulds Threading tools Cutting tools	Cutting tools	Cutting tools
Protection against adhesive wear	++++	++++	++++	++++
Protection against abrasive wear	+++	++++	++++	++++

Products coated with Argor-Aljba technology offer superior properties compared to conventional DLC coatings

Argor LUXURY

Type of coating	dianoir®	dianoir®G2	dianoir®G3
VDI abbreviation	ta-C	ta-C + a-C	a-C:H
Process	PVD Arc	PVD	PACVD
Composition (C:H)	100:0	100:0	70:30
Structure	amorphous	amorphous	amorphous
sp3 fraction [%]	70	40	40-60
Temperature of deposition [°C]	<100	<120	<190
Color	anthracite	black	intense black
Thickness [µm]	1	2	23
Density [g/cm3]	2.8	2.8-1.8	1.8-2.0
Max. operating temperature [°C]	500	450	400
Transparency [µm]	0.5-0-7	0.3	0.5
Hardness [GPa]	44	9-19	19-24
Hardness HV 0.05	4500	1000-2000	2000-2500
Adhesion	++++	++++	++++
Biocompatibility *	++++	++++	++++
Friction coefficient **	0.1	0.1	0.1
Electric resistivity [µΩcm]	10^7-10^9	10^7-10^9	10^7-10^{10}
Applications	Decorative Parts of watchmaking and jewelery	Decorative Parts of watchmaking and jewelery	Decorative Parts of watchmaking and jewelery
Protection against adhesive wear	++++	++++	++++
Protection against abrasive wear	+++	++	+++



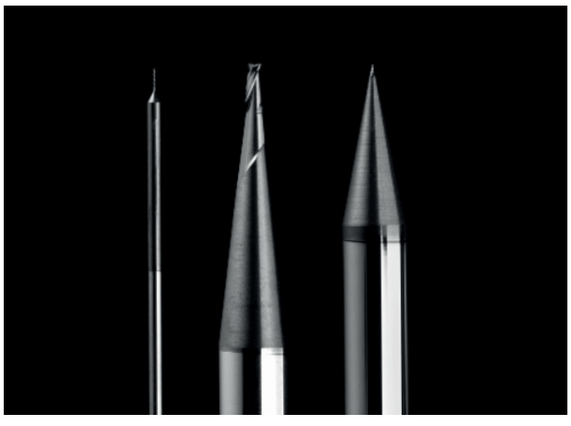
Argor Tool and Argor HP

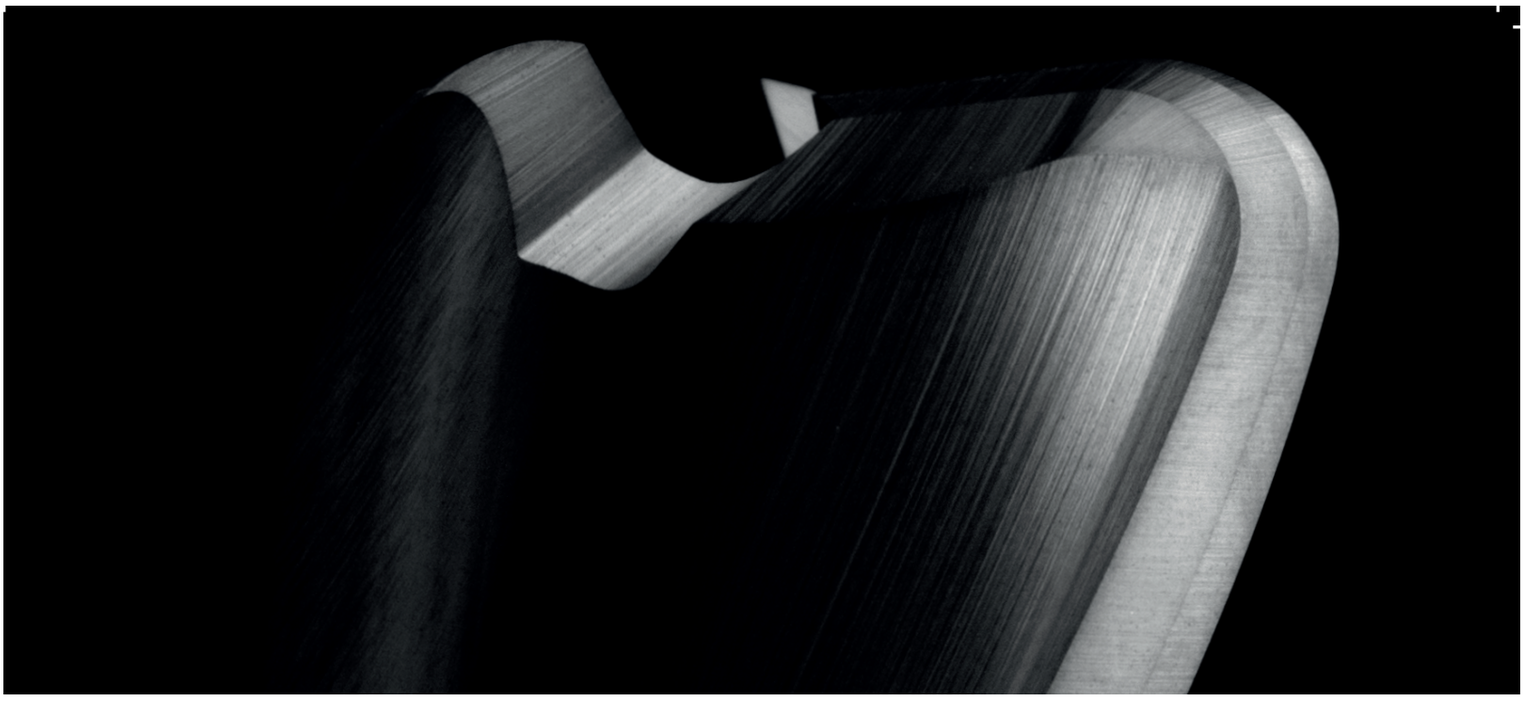
Argor Tool et Argor HP are the optimal solutions for the increased performance of tools and forms for many diverse applications. Form stability, consistency of formed parts and tool precision is conserved by the extremely thin layers who also grants no edge or blade rounding off. The low temperatures of the patented coating process (under 100° C) grant constant material properties of the tool. Re-sharpening is no problem: another coating can be applied afterwards to the tools without difficulty. Up to now it is possible to prolong the tool life by six times with dialong® coating. The corresponding cost savings surpass the coating costs by many times.

Machining (drilling, milling, turning, cutting etc.)

- Higher cutting speed and inferior cutting forces thanks to extreme hardness and lower friction: increased installation productivity.
- Higher durability thanks to strong protection against wear: clear reduction of costs, increased availability of the installation.
- Machining with less friction: reduction up to elimination of lubricating and cooling solutions and therefore less production costs and environmental pollution.
- Extremely thin layers: the form stability and tool precision is conserved, no edge or blade rounding off.
- The low temperatures of the patented coating process (under 100° C) grant constant material properties of the tool.

Test results confirm the superior properties of dialong®.





Stamping & Forming

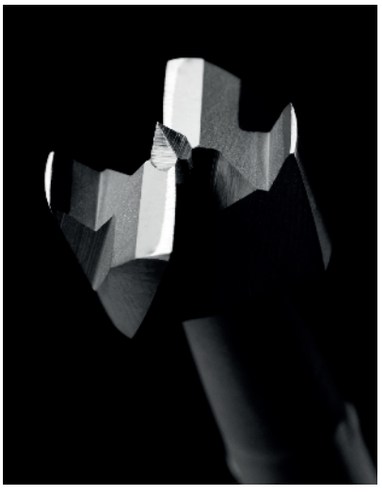
Frequent tool changes are to be avoided when stamping and reforming great series. The time lost by machine downtime costs money and tool wear additionally drives production costs up. With dialong® Argor-Aljba offers a product to protect effectively surfaces. Several aims can be met by applying dialong®:

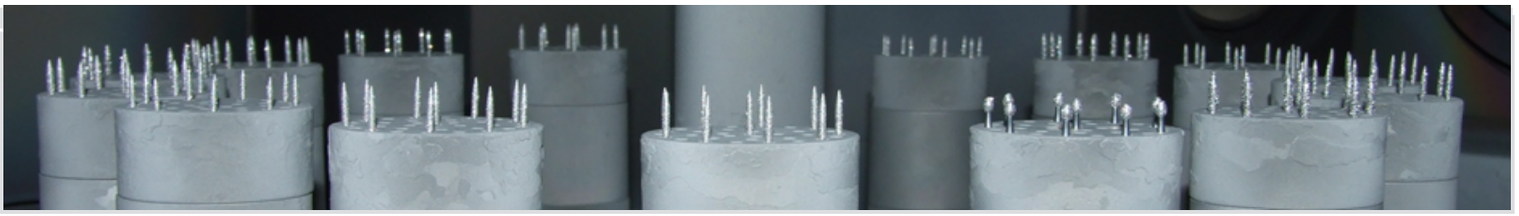
- Layer properties and reliable adherence lead to highly extended production cycles and reduced maintenance costs.
- High wear resistance prolongs life span of forms and stamps.
- The chemical stability of the layer allows the employment of the coated product even in difficult surroundings.

Wood machining

Coating of tools for wood machining was not spread on a grand scale until now. But the lately growing success of many applications, such as for example profile and reversal cutting plates or milling cutters is even more resounding:

- Tool life prolonged by many times thanks to strong protection against wear.
- Low friction coefficients lead to highly increased cutting speed.
- Higher surface finish of the machined wood thanks to great formconsistency of blades.
- Reduction of frequent and expensive tool change.





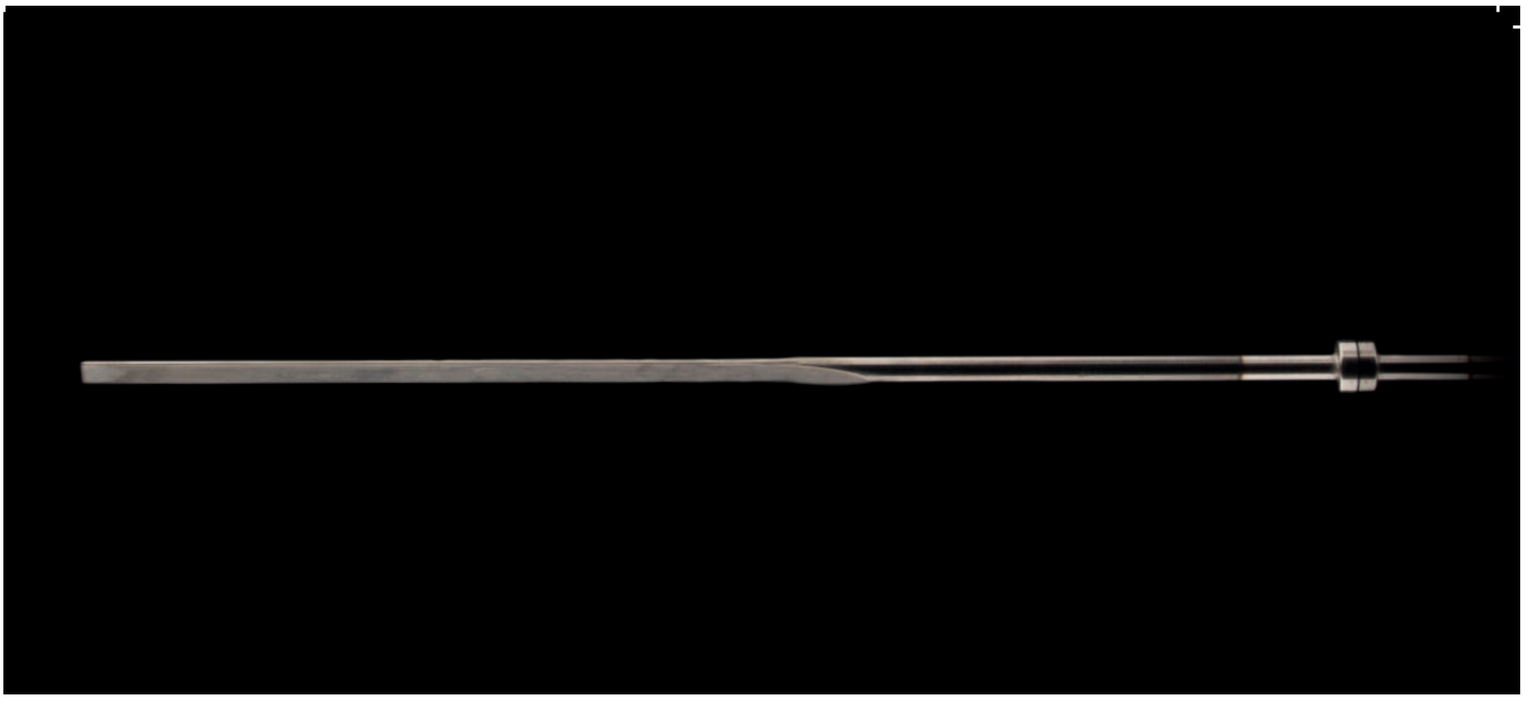
dropless®

New DLC coating technology: dropless®

The patented dropless® technology is the latest and pioneering development from Argor- Aljba. The dialong layer produced with the new dropless® technology brings the following performance improvements:

- Even higher diamond content in the DLC (sp3> 80%)
- Hardness up to 7000 HV
- A reduction of the droplets and thus an improvement in the surface roughness values
- An extremely dense layer and it provides a better protection against corrosion of the base material.

The new dropless® technology can be used for all technical applications where the layer dialong® achieves good results. With well-known customers has been demonstrated in long-term studies that dropless® layer had an increase in tool life by 75% compared to the standard dialong® layer.
Test whether the dropless® technology for your application brings even better performance and let yourself be convinced of the benefits. We see the high diamond content! The normally black DLC layers become by dropless® technology transparent (rainbow colors).



Wear Parts

Increase of Mean Time between Failures (MTBF).

- Higher availability of systems due to increased lifetime with dialong® coated components.
- The extremely thin layers, possibly in the range of nanometers, allow highly precise construction methods with simultaneous protection against wear.
- Coated components under high load show a clear increase of performance.
- The high wear resistance increases the lifespan of components and therefore cuts down maintenance costs.
- An extremely low friction coefficient allows the replacement of lubricants: a great advantage for example for applications in the medical or food processing domain.
- Reduced energy consumption due to less friction and lighter construction.

Motor sport

- Particularly suitable for racing motors and high performance applications, has been developed a new coating with outstanding proprieties.
- The dropless® aDLC is a coating that has the lowest possible friction coefficient with a extreme smooth surface.

dianoir®

With dianoir® we offer the watch and jewelry industry a solution for decorative and technical applications.

Watches & Jewelry

Highest aesthetical requirements combined with superior properties regarding scratch and wear resistance:

- The decorative black-anthracite color creates optimal pre-conditions for aesthetical applications.
- The corrosion and high wear resistance of dianoir® allows the use in challenging environmental conditions.
- The nontoxic process and the biological compatibility are optimal properties for the use of dianoir® on products that are in continuous human contact.
- A special intermediate layer grants an extraordinary strong adherence.
- 100% Swiss Made: dianoir® is made completely in Switzerland with a patented Swiss coating process.

Argor-Aljba is already supplier of well-known houses of the Swiss watch industry and holds broad experience in the coating of “carrures”, “lunettes”, “fonds”, “boucles”, and precision components etc. The superior properties of dianoir® were already confirmed by standard watch maker quality tests carried out by accredited Swiss Laboratories:

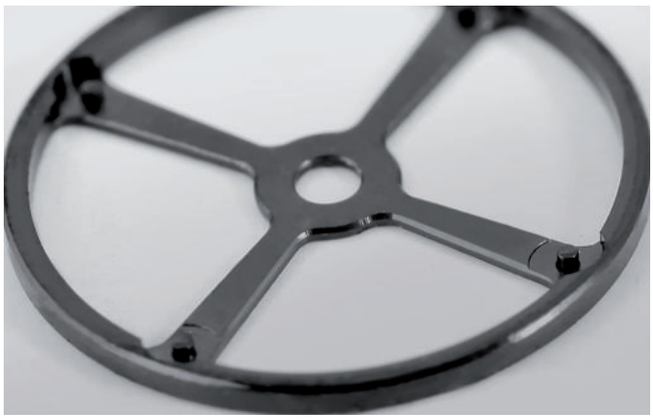
Standard watch maker quality tests of dianoir®	
• Resistance to saline agent test	excellent
• Resistance to artificial transpiration test	excellent
• Resistance to Vickers hardness HV 0.05 test	excellent
• Resistance to wear by vibration	excellent

Precision Components

Wear protection, saving of material and the reduction of lubrication solvents, come to the fore in many mechanical applications. Be it parts of watch movements or gearbox construction parts:
The use of dianoir® allows new solutions for precision components – especially in the watch industry:

- The extremely thin layers, possibly in the range of nanometers, allow highly precise construction methods with simultaneous protection against wear.
- Coated components under high load show a clear increase of performance.
- The high wear resistance increases the lifespan of components and therefore cuts down maintenance costs.
- An extremely low friction coefficient allows the replacement of lubricants.

Argor-Aljba detains broad experience in coating precision components of the most diverse materials (brass, steel, hard metals, precious metals, sapphires etc.) and construction parts (wheels, anchors, mainsprings, barrels, ratchet wheels, quadrants etc.). Test results confirm the superior properties of dianoir®.



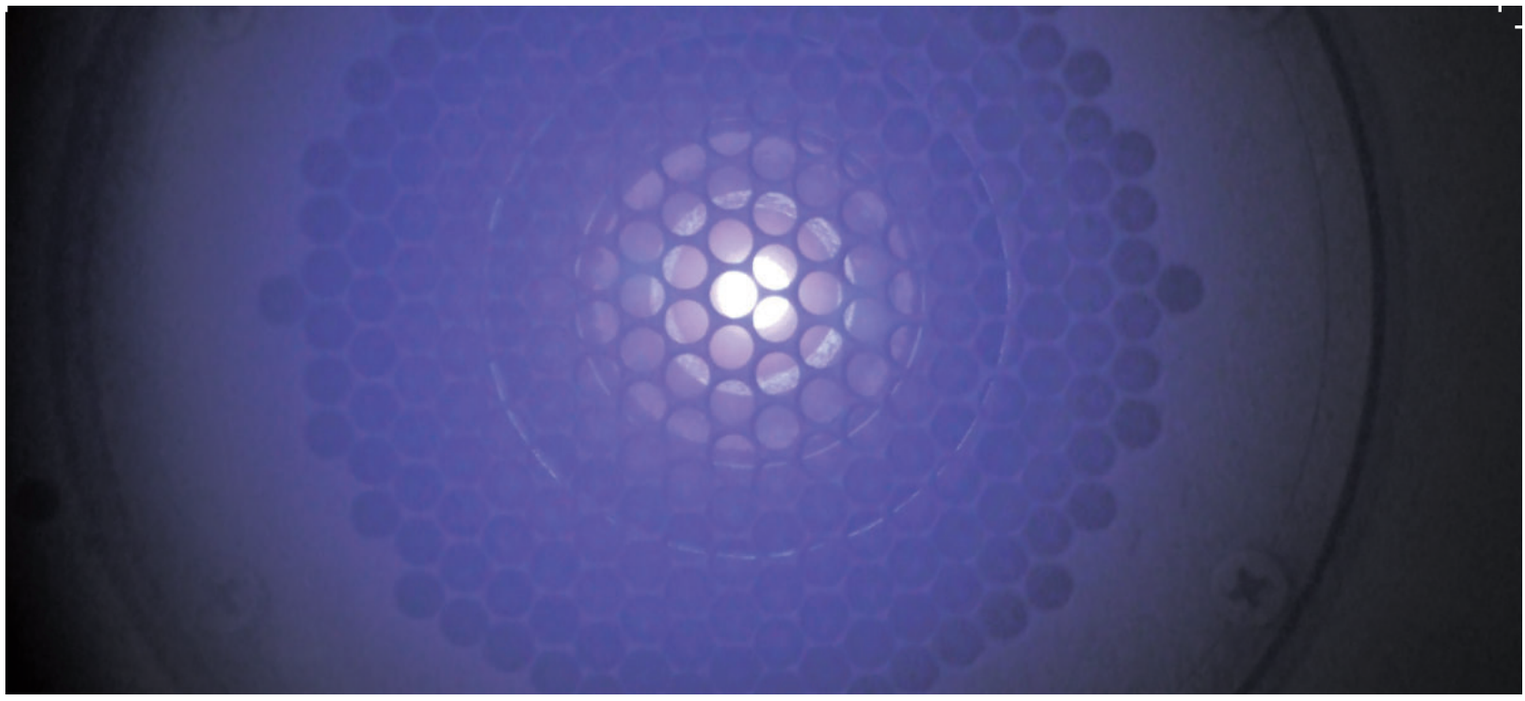
dianoir®

Dark dianoir®G2

For precision components in watch movements we developed an especially dark coating - dianoir®G2:

- extreme good adhesion on brass and nickel parts
- very high homogeneity of the coating
- no temperature influences due to low process temperature (<100°C)
- high form constancy of the coated parts
- resistant to climate test and a excellent UV resistance
- utmost high chemical resistance

This clean technology is a excellent alternative to galvanic coatings, because is a black, stable coating with a long lifetime.
The dianoir®G2 coating is 100% compatible with the REACH regulation, unlike the galvanic layers is produced Crom VI free.

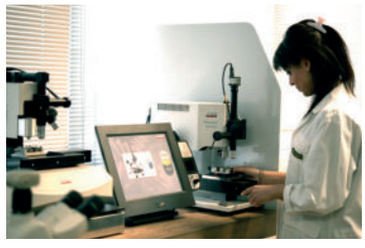


About us

Since 1995 Argor-Heraeus SA has been collaborating with a Russian partner on research and development of a technology of protection coatings (protection against friction and abrasion) for tools, precision instruments and decorative components. Seeing the positive response to these developments, the joint-venture partnership was legalized by the constitution of a new company: Argor-Aljba SA. The result of its decade o scientific research within the realm of extremely thin and high performance coatings is a unique patented filtered arc PVD process for the deposition of DLC coatings (Diamond-Like-Carbon). It‘s a solution for industrial and aesthetical applications of exceptional hardness within the field of DLC-Coatings and is employed to protect surfaces from wear and to reduce friction. Today, Argor-Aljba is a fast growing company, serving the high demand for innovative new coatings for different industries and numerous applications.

Our Technology

The focus of Argor-Aljba is the production and the development of high-tech coatings. DLC coatings are composed of pure carbon, which to a great extent possesses the same structures like a diamond. This grants outstanding properties, such as hardness, wear resistance and low friction coefficient. Argor-Aljba is able to apply processing temperatures of under 100° C. This permits almost any material to be coated, without effect on the material properties.
During the filtered arc PVD process, pure carbon is vapor-deposited under controllable conditions directly onto the substrate – a special patented technology that is particularly efficient. Furthermore it grants form stability of the coated objects, without rounding off edges. Therefore, the results obtained through the Argor-Aljba technology among other normal DLC-layers captivate through notably favorable conditions – and come very close to those of a diamond.



More information’s on www. argor-aljba.com

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ARGOR-ALJBA SA

Switzerland
Via F. Borromini 20, CH-6850 Mendrisio
Tel +41 91 222 83 59, Fax +41 91 646 46 60
info@argor-aljaba.com

www.argor-aljba.com

MADE IN SWITZERLAND