PLATIT's new DLC coatings

Diamond hardness & graphite lubrication combined

written by **Dr. Hamid Bolvardi, Dr. Jan Kluson, Mojmir Jilek, Christian Galamand and Dr. Andreas Lümkemann**

Diamond-like Carbon (DLC) coatings have unceasingly absorbed overwhelming interest from industry as well as academic research institutions within last years.

High hardness and elastic modulus, chemical inertness, optical transparency, superior tribological properties and good corrosion resistance as well as high biocompatibility and resistance to bacterial colonization make DLC an engrossing coating system. Owed to the unique and broad range of properties, DLC coatings are constantly employed in new applications from cutting and forming tools to components; saw blades, end mills, micro-tools, punches, injection and extrusion molds and dies, automotive, decorative, medical applications are just few raised examples here.

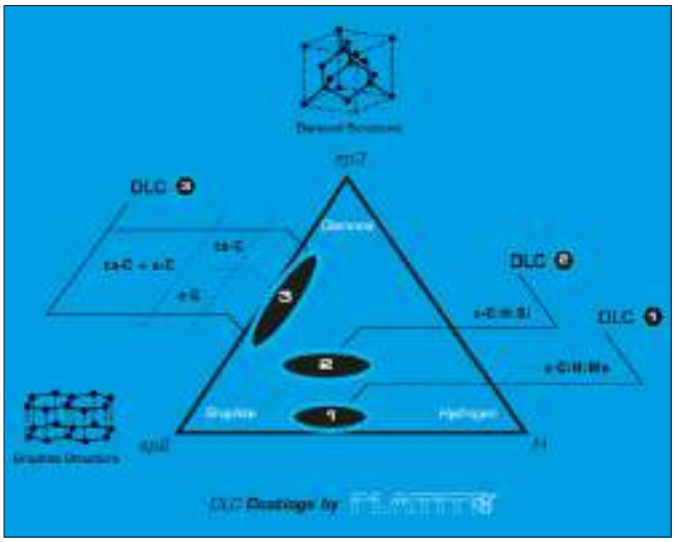

figure 1
PLATIT's DLC coatings portfolio

PLATIT's coating portfolio comprises three DLC coating types which are aimed and fine-tuned to address specific market and application needs *(figure 1)*. DLC[1] and DLC[2] are hydrogen containing and DLC[3] is the hydrogen free coating generation *[1, 2]*. DLC coatings consist of a mixture of sp^3 (diamond) and sp^2 (graphite) bonds. The higher sp^3 bond fraction results in a higher density, hardness (at ambient and elevated temperature), thermal stability, oxidation resistance, higher residual stress and lower thermal conductivity *[3, 4, 5]*. DLC[3] (ta-C) with the highest sp^3 content, i.e. >50%, is fine-tuned mainly for tools and particular components. DLC[1] and DLC[2] are specifically aimed to address application challenges in components and sliding contacts.

PL711 DCMS & HiPIMS coater: dedicated design, high productivity

The PLATIT's PL711 coating machine is an ideal solution with a new dedicated design for coating components with DLC at high productivity and low maintenance intervals. Despite of all DLC acquainted advantages, typically DLC coating machines would require cleaning intervals which leads to additional costs and machine downtime. Along of PLATIT's PA3D module (new designed lateral Helmholtz coils) carbon plasma will be confined to carousel as schematically illustrated in *figure 2*. This innovative design will significantly reduce the chamber contamination and increase the deposition rate and productivity, i.e. an ideal design specially for hydrogen containing DLC coatings.

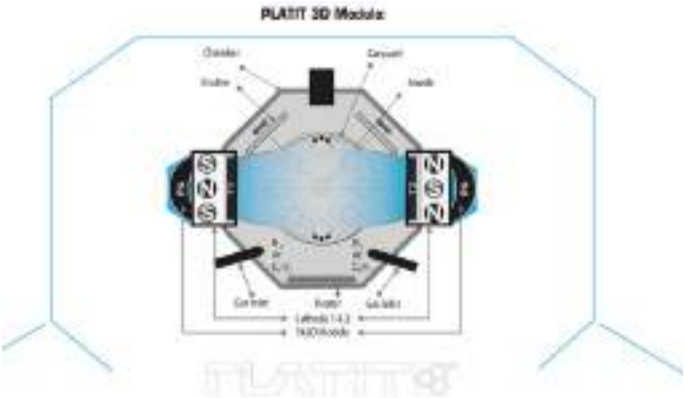

figure 2
PLATIT's PL711 highly productive DCMS & HiPIMS coater

Pi411 PLUS arc and sputtering coater: ultra-flexible

Due to its modular design and the range of available technologies, e.g. arc, sputter, PECVD, OXI processes, Pi411 PLUS is the world's most flexible coating unit. PLATIT's new DLC[3] (ta-C) is a sputtered coating with SCIL® technology requiring no hardware change in Pi411 PLUS coater compared to prior or later nitride or oxynitride batches.

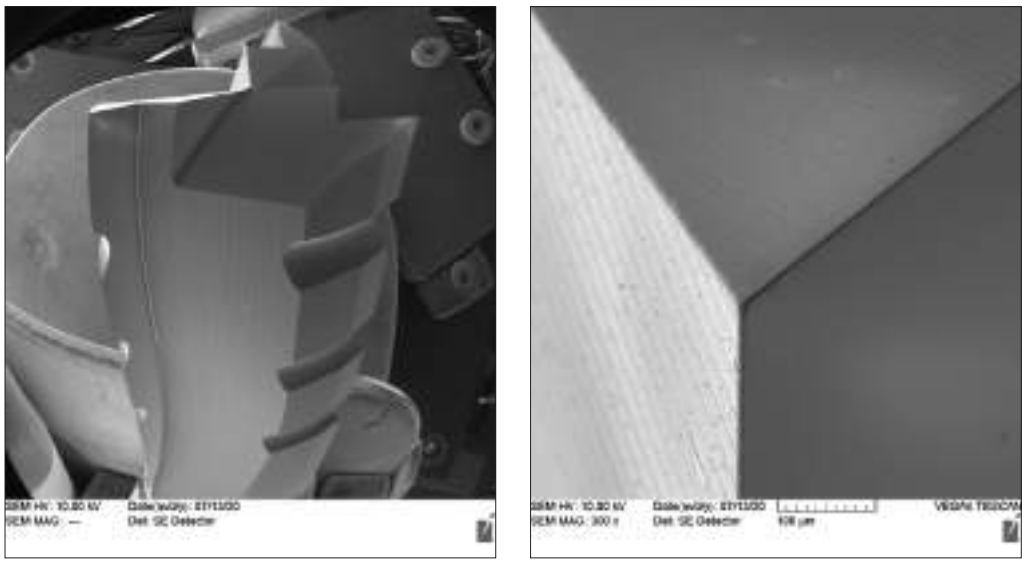

figure 3 - DLC³ coated endmill under scanning electron microscope

References

[1.] ***www.platit.com***

[2.] ***Compendium - PLATIT AG***

[3.] ***M. Kamiya et al.,*** *Vacuum 83 (2009), page 510 - 514*

[4.] ***A.C. Ferrari et al.,*** *Appl. Phys. Lett. 75 (1999), page 1893 - 1895*

[5.] ***R. Kalish et al.,*** *Appl. Phys. 74 (1999), page 2936 - 2938*

[6.] ***T. Cselle et al.,*** *Werkzeug und Technik, no 183, August 2020*

PLATIT's sputtering SCIL® technology with unique rotating cathodes, enables the synthesis of the new high quality DLC coatings *(figure 3)*. High magnetic field strength inside the SCIL® sputter cathode and its very efficient target cooling together with substrate heat management during deposition fabricate the hardest sputtered ta-C on the market as of today. Hardness value of 45-50 GPa and >50 % sp^3 content are features of PLATIT's new DLC³. Along with achieved high coating hardness values, good productivity and low coating machine maintenance intervals are maintained.

Compared to other ta-C synthesis methods like filtered cathodic arc, where higher hardness values are theoretically feasible, SCIL® sputtered DLC³ has a much higher productivity, i.e. deposition rate. Additionally, deposition process runs more stable and coating small size tool geometries as we have for micro tools is realizable without the risk of overheating and adverse effects thereof.

Figure 4 exhibits superiority of ta-C combination of high hardness and low friction in case of a DLC coated moving ceramic part of a water tap. This allows for much higher lifetime, which is the number of opening and closing cycles, at a lower and stable friction torque. The PLATIT's fine-tuned DLC coating portfolio allows for a pertinent choice for each application ranging from tribological and sliding contacts to micro-cutting tools. For further technical information and DLC coatings performance in diverse applications please refer to *references 1 and 2* or contact PLATIT AG.

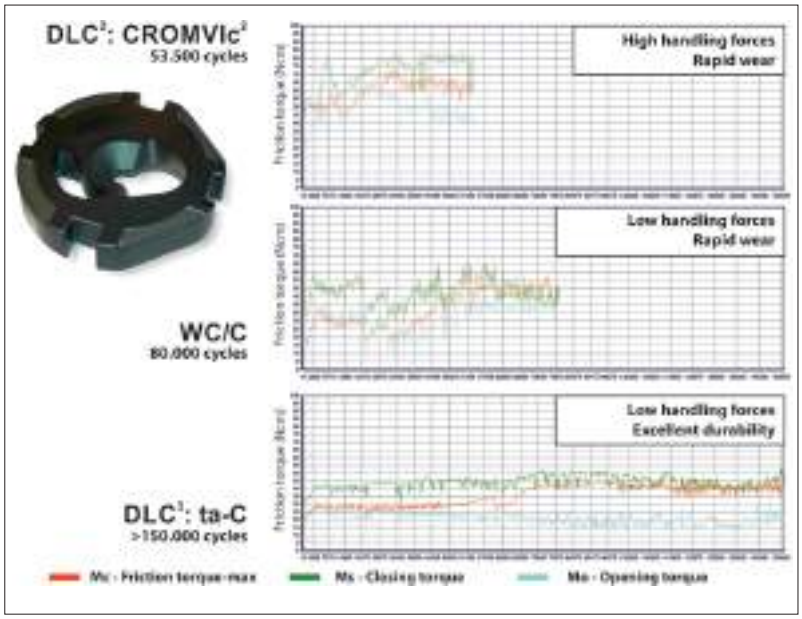

figure 4
Comparison of the frictional torque of different DLC-coatings on a ceramic closure wear element in a water tap [6]

PLATIT
is an independent, family-owned company headquartered in Selzach, Switzerland as well as a leading manufacturer of high-tech PVD and PECVD hard coating equipment for tools and machine components. With over 550 installed systems worldwide, own service, support and sales offices in Europe, North America and Asia, PLATIT maintains close partnerships with its customers.