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High Rate HiPIMS for Cutting Tool Coatings

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A deposition rate as high as possible is a key a requirement to every commercial coating process. This paper introduces a new HiPIMS concept for increasing the deposition rate. The concept is based on the CemeCon door-assembly design, which works without any cable between pulse unit and cathode, and features a full synchronization between the HiPIMS sources and a dedicated table Bias. Plasma characterization demonstrates that this results in highest ionization. Together with reduced re-sputtering this novel process regime gives a so far unachieved deposition rate for HiPIMS. Case studies show how this new hardware and process design turns the advantages of the HiPIMS technology such as enhanced film adhesion, denser morphology and better coating uniformity into user benefits for cutting tool applications.
A lot of research is currently dedicated to the machining process of titanium and heat resistant super alloys based on nickel, iron or cobalt. Jet engines and gas turbines made of this material class operate at a higher working temperature and thereby raise the energy conversion effiency. Key obstacle to productive metal processing are the extreme cutting temperature, the high strength and the tendency to stick to the carbide substrate of the tool. TiB_2 films are a promising candidate due to the high hardness of this ceramic material and its low affinity to non-ferrous metals.
Case studies show how a dedicated HiPIMS process leads to fine-grain TiB_2 morphology. The films show hardness levels above 4.000HV - which is typical for TiB_2 - combined with low Young's modulus. High toughness makes it rather suitable for operations like thin wall machining for jet engines. Milling tests in the aircraft sector demonstrate how the superb adhesion of HiPIMS supports the machining of titanium and super alloys further.

Keywords
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