Thick a-C:H:Si coatings on cast iron by means of DC pulsed PACVD

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Stamping dies in the metal-forming industry are more often very large in size reaching dimensions up to several meters. Cast iron is the favored material for such huge dies due to saving of material costs as well as good reparable and machinability. Due to the lack of sufficient hardness, these tools suffer from die wear especially at corners and flanks. Additionally adhesive material transfer is a problem to face. Further this material has unfavorable mechanical properties and is poor to support any type of tribological hard coating.

This work presents a novel thick a-C:H:Si coating deposited on cast iron substrates that can withstand highly loaded process conditions. With higher coating thickness this a-C:H:Si film gets self-sustaining increasing the load carrying capacity. A pretreatment process (plasma nitriding) can be performed prior to the a-C:H:Si coating step to further improve the load bearing capacity. The deposition technology offers the possibility to upscale the system enabling large area coating in one batch. These a-C:H:Si coatings were deposited in an industrial DC-PACVD-system. The topography and the chemical composition of the deposited layers were characterized by SEM and EDX. The hardness was evaluated by a nano-indenter and the adhesion by means of a scratch tester reaching values up to 48 N. The influence of prenitriding and the film thickness on the adhesion and on the tribological behavior is shown. The friction tests were performed using a pin-on-disc tribometer with a friction coefficient down to 0.06.

Due to the high load carrying capacity of these coatings they can also be applied on plain carbon and low alloyed steels used in mechanical engineering. Therefore this plasma process offers the possibility to open completely new fields of applications for DLC-coatings.

Keywords
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