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The effect of deposition parameters on structure, mechanical and adhesion properties of DLC on Ti6Al4V with gradient Ti-TiC interlayer.

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Diamond-like carbon (DLC) thin films have promising properties in wear and biomedical applications due to their outstanding tribological and biocompatible properties. In particular, biomedical implants with direct contact to human tissue or blood can be tailored with such type of thin films for better biocompatibility and osseointegration. Nonetheless the poor adhesion of DLC thin films on medical grade TiAlV alloys reduces their range of application. Therefore the improvement and understanding of adhesion/cohesion of the DLC-metal substrate system is mandatory to widen their usability. In this study, DLC was deposited onto medical Ti Grade 23 (Ti6Al4V ELI) substrates with a Ti- and gradient Ti-Ti_xC_y interlayer using a radio frequency plasma enhanced chemical vapor deposition (RF-PECVD) process . The deposition parameters like pressure and substrate bias voltage during the deposition of DLC, as well as the C_2H_2/Ar ratio and deposition power during Ti_xC_y deposition were varied. The layer systems mechanical and adhesion properties were characterized by nanoindentation and scratch testing. Additional adhesion testing in form of bending tests captured with a high speed camera was performed. The samples grain microstructure was examined by etching and SEM imaging. Nano scratch tests with a berkovich tip revealed enhanced adhesion of DLC through a Ti interlayer with a critical load of around 90 mN. With introducing a gradient Ti-Ti_xC_y interlayer a change in the adhesion/cohesion behavior was found to further improve the adhesion. Bending tests give deeper insight into the adhesion/cohesion behavior. The coating systems micro hardness is around 12 GPa. Etching tests show that no change in the substrates grain microstructure through the deposition process is present.

Keywords
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critical load