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DEVELOPMENT OF SILVER-DOPED HYDROGENATED AMORPHOUS CARBON FILMS (a-C:H) WITH RESPECT TO THE ANTIBACTERIAL AND MECHANICAL PROPERTIES

Helge Decho[1], Heinz-Rolf Stock[1], Andreas Rabenstein[2], Jan Küver[2]

[1]Stiftung Institut für Werkstofftechnik, Bremen, Germany [2]Amtliche Materialprüfanstalt Bremen, Bremen, Germany

decho@iwt-bremen.de

In this study the antibacterial properties of silver-doped hydrogenated amorphous carbon (a-C:H) films are investigated with respect to the mechanical properties so as the wear resistance.
The films are deposited on steel substrates by pulsed DC magnetron sputtering in a Cemecon CC800 unit. For the mechanical characterization hardened 100Cr6 samples and for the antibacterial characterization hardened and tempered X42Cr13 samples were used. The silver-doping was realized by sputtering graphite targets with inserts of pure silver (99,95%). The silver content was varied by changing the size and the number of inserts in the targets. The sputtering was done under a mixture of argon, krypton and acetylene. For better adhesion all a-C:H films were deposited on a chromium nitride interlayer. The influence of bias voltage, target power and the silver content on the mechanical and antibacterial properties was investigated. Ultra-microhardness, atomic force microscope, ball-on-disk, electron microscopy, XPS and SIMS measurements were conducted to obtain the mechanical and chemical properties of the films. The antibacterial properties were investigated by immersion test in tap water and tests based on JIS 2801:2006/ISO 22196.
It was found that the mechanical properties decrease with increasing silver content in the film. For low silver contents the lost in hardness could be compensated by increasing the bias voltage. For the films with higher silver contents a lost in hardness could not be avoided. With increasing silver content and decreasing bias-voltage the antibacterial properties of the films were enhanced.

Keywords
a-C:H
silver-doping
antibacterial properties
bias voltage
magnetron sputtering