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Comparison of surface properties of DLC and ultrananocrystalline diamond films with respect to their bio-applications

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Surface and antibacterial properties of diamond-like carbon (DLC) and ultrananocrystalline diamond (UNCD) films were studied and discussed. The DLC layers were prepared by pulsed laser deposition (PLD) with laser energy densities from 4 J•cm^{-2} to 14 J•cm^{-2} and PLD combined with ion bombardment. The percentage of sp^2 and sp^3 bonds was calculated using X-ray photoelectron spectroscopy (XPS). Depending on the laser energy density and the bombardment energy the amorphous films contained from 40 % to more than 80 % of sp^3 bonds. Microwave plasma chemical vapor deposition (MWCVD) from 17% CH_4 in N_2 mixture was used for the preparation of UNCD films. They are composed of diamond nanocrystallites (3-5 nm in diameter) embedded in an amorphous carbon matrix, containing up to 30% sp^2 bonds. The ratio of the crystalline and amorphous fractions is closed to 1.
The morphology and topology of the films were studied by scanning electron microscopy (SEM) and atomic force microscopy (AFM), which revealed closed, uniform, homogeneous and smooth coatings. The wettability and the surface free energy were determined from the contact angle measurements, and were related to the surface topology and content of sp^3 bonds. The antibacterial properties investigated with Gram-positive and Gram-negative bacteria were discussed with respect to the surface properties of the DLC and UNCD films.

Keywords
diamond- like carbon
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antibacterial tests