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Comparison of the wear particle size distribution of different a-C coatings deposited by vacuum arc

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For biomedical application in the field of artificial hip joints diamond-like carbon (DLC) coatings have been widely studied due to their excellent mechanical, tribological and biological properties. The wear particles as the main factor limiting the life expectancy of hip joints have attracted more and more interest, not only the number of them, but also the distribution of their size. In this study we have deposited DLC coatings on stainless steel (P2000) by a vacuum arc adjustable from anodic to cathodic operation mode, with different anode-cathode diameter ratios of d_a/d_c=1/3 and 3/1 at a DC bias of -250 V to -1000 V. To improve the adhesion of the DLC coating on P2000, titanium as a metallic interlayer was deposited by cathodic vacuum arc evaporation. The internal structure of the coating was investigated by the visible Raman spectra with the four-Gaussian curve fitting method. The frequency distribution of wear particles generated using a disc-on-disc test was measured by a particle size analyzer. Comparing the results with the previous work (coatings deposited with d_a/d_c=1/1), it was found that the anode-cathode diameter ratio has an effect on the structure (e.g. I_D/I_G) as well as the wear particle size distribution. It was shown that the maximum of the frequency distribution e.g. at – 1000 V bias can be shifted to below 1 µm with increasing d_a/d_c.

Keywords
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