

WARSTWY NANOKRYSTALICZNEGO DIAMENTU NA IMPLANTY DENTYSTYCZNE

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Streszczenie

Różne rodzaje warstw węglowych otrzymanych różnymi sposobami, między innymi warstwy diamentopodobne (DLC) [1-3] oraz warstwy nanokrystalicznego diamentu (NCD) [4-8] otrzymane w procesie rozkładu metanu w polu wysokiej częstotliwości RFPACVD (RYS. 1), są w wysokim stopniu biokompatybilne. W zależności od parametrów nanosenzenia, różnią się one bio-fizycznymi oraz mechanicznymi właściwościami, DLC są amorficzne i zawierają około 60% diamentu oraz 40% grafitu, NCD składają się niemalże całkowicie z czystego diamentu. Zastosowanie warstw węglowych w medycynie jest znane od wielu lat.

Prace nad implantami stomatologicznymi rozpoczęły się ponad dziesięć lat temu.



FIG.1.
RFPACVD
apparatus.

Piśmiennictwo

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References

NANOCRYSTALLINE DIAMOND COATINGS FOR DENTAL IMPLANTS

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Abstract

Different kinds of carbon coatings, obtained by different methods are highly biocompatible, among them both diamond-like carbon (DLC) [1-3] and nanocrystalline diamond (NCD) [4-8] coatings obtained with the radio frequency plasma activated chemical vapour deposition (RFPACVD) process (FIG.1). They have different bio-physical and mechanical properties, in dependence of the parameters of deposition; DLC are amorphous coatings consisting of about 60% diamond and 40% graphite, NCD contains almost pure diamond. The application of carbon coatings in medicine is investigated for many years.

Research on dental implants has begun more than decade ago. Olborska and all [1] has explained the good mechanical properties of amorphous carbon coatings – DLC. Amorphous carbon (a-C) coatings, obtained by RFPACVD method, were deposited on implants used in maxillofacial surgery and on the dental prostheses. In all cases the substrate was the medical steel AISI 316L. After that the coating was investigated by Auger electron spectroscopy (AES). AES results show that the surface layer consists of carbon and the interface layer consisting of the substrate carbides (i.e. Cr, Ni, Mo, Fe) makes the coating more adhesive and improves its quality.

However, the next generation coatings – NCD, improved in many ways the mechanical properties of the first carbon coatings.

Nanocrystalline diamond coatings (NCD), possess the unique bio-medical and mechanical properties and so have found many applications in medicine. NCD is about 1µm thin coating with a very high adhesion to substrate thanks to the interface layer containing substrate carbides. It consists almost pure diamond, the crystals are of the sizes of nanometers. The small amount of graphite, on the grain boundaries, even improves the mechanical quality of the coating, it is less brittle.

NCD can be coated on different materials [4,5], such as titanium and its alloys or medical steel AISI316L, especially interesting are its applications as the coatings for medical implants. Investigations, lasting for many years, show the high biocompatibility of NCD and its good mechanical and physico-chemical properties, it is also resistant to bacterial colonization [8].

Nanocrystalline diamond is also used as the coating for artificial heart valve [6] because of its hemocompatibility and for dental implants.

Dental implants have been coated with nanocrystalline diamond by RFPACVD method. Then their surface was analyzed by Raman Spectroscopy, Atomic Force Microscopy and Scanning Electron Microscopy. The good quality, uniform NCD coating, obtained on the dental implants surface, is a promising material in this area of research.