

# RAMAN SPECTROSCOPY FOR SURFACE EVALUATION OF TITANIUM ALLOYS

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Improvement of metal fixators is one of the main tasks of modern reconstructive surgery. In addition to strength characteristics, more and more attention is paid to the biointegrative properties of implants, which largely determine the effectiveness of the operation, the life of the implant, and the quality of life of patients. Improvement of endoprosthesis coatings is an actual problem of traumatology and orthopedics. The surface characteristics of implants often play a decisive role in bacterial adhesion and subsequent biofilm formation on the implant. It is of interest to create coatings for implants that prevent such complications.

The aim of the work is to evaluate the surfaces of implant samples with different types of coatings using Raman spectroscopy.

We have evaluated the spectral characteristics of the surfaces of implant samples based on VT6 titanium, fabricated using selective laser sintering technology. The samples were divided into groups. The first group included samples without coatings; in the second, samples coated with calcium hydroxyapatite. The third group consisted of samples coated with calcium hydroxyapatite, which was additionally coated with an antibacterial agent. The fourth group included samples coated with a

film containing chitosan. All samples were sterilized by standard methods used in medical clinics.

The differences between groups 4 and group 1 are determined by changes in the Raman intensity on the lines  $\sim 1260$ ,  $\sim 1416$ ,  $\sim 1665$  and  $1748 \text{ cm}^{-1}$ . The indicated Raman lines  $\sim 1260$ ,  $\sim 1416$ ,  $\sim 1560$ ,  $\sim 1665$ ,  $1748 \text{ cm}^{-1}$  do not appear in the group of samples 2, but the lines in the region  $950 - 1050 \text{ cm}^{-1}$  corresponding to the lines of hydroxyapatite  $955-961 \text{ cm}^{-1}$  ( $\text{PO}_4^{3-} (\nu_1)$ ) and  $\sim 432 \text{ cm}^{-1}$  ( $\text{PO}_4^{3-} (\nu_2)$ ).

In group 3, the Raman intensity in the region of  $950-1050 \text{ cm}^{-1}$  is less pronounced than in the group of samples 2, and there are also Raman lines  $\sim 1260$ ,  $\sim 1448$ ,  $\sim 1560$ ,  $\sim 1665$ ,  $1748 \text{ cm}^{-1}$ . In group 3, a pronounced Raman line  $870 \text{ cm}^{-1}$  (Benzene ring of hydroxyproline) is determined.

As a result of the studies, the spectral differences between the surface of implant samples with different types of their coatings based on VT6 titanium were established using Raman spectroscopy.