

Plasma-sprayed HA coatings in orthopedics



Principles

The technique of coating implant surfaces by using plasma-sprayed powders has a proven record of success that spans several years in the field of medical technology for the reproducible production of implant surfaces with defined properties.

To be currently considered as optimal, an implant surface must be both macroporous and biocompatible with bone metabolism.

Calcium phosphates are used primarily in medical coating technology as they promote a rapid bone tissue growth. They also promote a strong bond between the implant and the surrounding tissue, thereby shortening the healing period.

Technology

The HA-sprayed coatings are applied to the implants via plasma spraying. In this process, a gas mixture is heated to as high as 20,000 °C and ionized by a high-energy electric arc. When heated to high temperatures, the gas expands and exits the nozzle at extreme high speeds.

The powder coating material is melted in this highly-energized plasma jet and it is then applied to the implant surface. The microstructure, the density and the porosity of the coating can be defined by the grain size of the coating powder used, the temperature and the speed of the particles.

By applying HA coatings, the surface topography of implants can also be modified over a very wide range, thereby allowing for a controlled influence on osseointegrative tissue formation on implant surfaces.

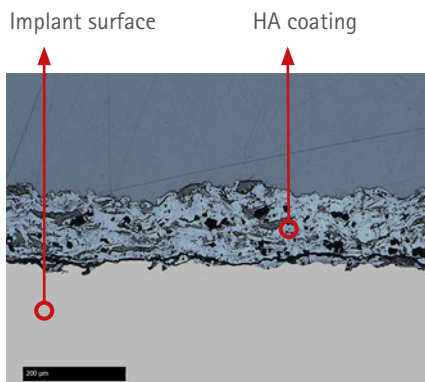


Advantages

- Flexible coating thicknesses are possible
- Controlled resorption due to a high degree of crystallinity
- High primary stability of the implant due to its structured and roughened surface
- Raw material complies with ASTM F 1185

Properties

Physical & Chemical Properties



Micrograph of an HA-sprayed surface

Property	Result
Color	Light gray
Ca/P ratio	$1.61 \leq x \leq 1.76$
Coating thickness	20 – 150 µm
Coating adhesion (adhesive tensile strength) ASTM F1147	≥ 15 MPa (Limits according to ISO 13779-2)
Coating adhesion (shear strength) (ASTM F1044)	≥ 15 MPa (Limits according to ISO 13779-2)
Crystalline phases / phase composition	HA: ≥ 50 w% ^{*1} Sum of α-TCP, β-TCP and TTCP: ≤ 30 w% ^{*2} CaO: ≤ 5 w% ^{*2} (Limits based on ISO 13779-2)
Degree of crystallinity of HA phase	≥ 45 % (limits based on ISO 13779-2)
Purity of the coating:	Limits in accordance with ASTM F1609 and ISO 13779-2

^{*1} Relative to the total mass of the coating

^{*2} Mass fraction of different phases relative to the mass of the crystalline HA fraction

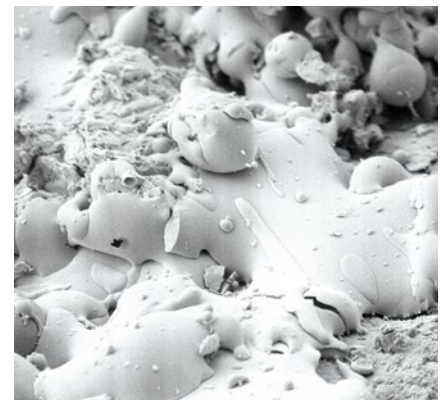
Crystallographic Properties

The degree of crystallinity is ≥ 45%.

The Ca/P ratio is in the range of 1.61 to 1.76.

The high velocity of the particles results in a high adhesion strength of the HA coating.

A porous, crystalline surface is created by fusing the HA powder. This structure provides bone cells with optimal conditions for the implant to become firmly anchored in the bone tissue.



SEM images of an HA-sprayed surface

Areas of Application

Orthopedic implants and their components



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with you!

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DOT – Specialist for the coating of orthopedic and dental implants

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