DMT TECHNOLOGY
for Surface Coating of Artificial Joint

Sales & Marketing Department
Insstek, Korea
Success of joint replacement is dependent on solid fixation between bone and artificial joint.
For solid fixation between bone and artificial joint surface of artificial joint needs a porous structure like Cancellous bone.
Ideal porous structure for bone ingrowth into metal surface

- Pore size: 100-400um
- Porosity > 50%
- Rough surface
Conventional Fabrication methods for porous structure of artificial joint

- Sintered bead (Depuy: AML)
- Fiber metal (Zimmer)
- Plasma spray (Biomet, Aesculap)
BEAD COATING
Mixture of bead & binder

Extreme heating to create coating attachment

2200-2400 F

bead attachment
Problems of bead coating

- Structural change due to extreme heating process
- Debonding between coating layer & substrate
- Weak mechanical strength
- Low porosity, Low surface roughness
DIFFUSION BONDING
Pre-shaped wire pad is fitted into matching recess of substrate

1400-1800 F

Diffusion Bonding (Zimmer)
Problems of diffusion bonding

- Debonding between coating layer & substrate
- Low porosity, wide range of pore size
- Low surface roughness
- Low mechanical strength
- High cost
PLASMA SPRAY COATING
Plasma Spray
Fatigue strength at $10^7$ cycles:

- **Uncoated**
- **Sintering**
- **Diffusion bonding**

Plasma spray
Problems of plasma spray

- Debonding between coating layer & substrate
- Low porosity, wide range of pore size
- Technical demanding
- High cost
Debonding of plasma sprayed coating
Ideal coating methods for artificial joint?

Easy technique
Low cost (rapid fabrication time, less material loss)
Fabricate ideal porous structure
No bonding between coating layer & substrate
Direct coating on casting & forged implant
Ti coating on Co-Cr
Broad application fields
DMT COATING

1. What is DMT coating?
2. Characteristics of DMT coating
3. Application fields
4. Application materials
5. Manufractural advantage of DMT coating
6. Economic advantage
7. Advantage compare with PBF metal printing
DMT COATING

1. What is DMT coating?
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What is DMT coating?
Direct deposition of titanium particles on the implant surface using a INSSTEK’s unique 3D metal printing technique.
A Laser-Aided Direct Metal Tooling Technology for Artificial Joint Surface Coating

Fig. 1 Development of an artificial joint surface coating based on a laser-aided direct metal tooling (DMT) technology

Fig. 2 Representative scanning electron microscopy (SEM) images of DMT (left) and titanium plasma (TPS) specimens
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Characteristics of DMT coating

Ideal pore size (100-400 um)
High porosity (>60%)
High surface roughness
Strong interfacial bonding between coating layer & substrate
DMT coating: Strong chemical bonding

Strong interfacial bonding between coating layer & substrate

SEM of Porous Coating by DMT
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DMT coating: Application fields
Hip, Knee, Ankle, Shoulder (depend on custom request)
DMT coating: Hip system
DMT coating: Knee system
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DMT coating: Application materials
Titanium, Cobalt Chrome, Stainless Steel

Ti on Ti alloy

Ti on Co-Cr alloy
Ti coating on Co-Cr alloy?

Cementless Knee: TKR, UKR
Co-Cr acetabular cup for Resurfacing and Dual-mobility cup
Ti coating on Co-Cr alloy with Insstek’s DMT technique

EFORT Jacques Duparc Award of the 17th EFORT Congress

Enhanced Biocompatibility of Co-Cr Alloy by Titanium Powder Coating using 3D Metal Printing
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DMT coating: Manufractural Adv.

Easy to operate
Rapid fabrication time
Easy control of pore shape, thickness, roughness
Coating on the cast & forged implant is available
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DMT coating: Economic Adv.
Rapid fabrication time
Less material loss
Different implant with one machine
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DMT VS PBF Printing

Commercial 3D printed coating
(Powder bed fusion 3D printing)

• Long build up time as total parts are to be produced by 3D printing
• Pores in the structure and low mechanical strength
• Very expensive process

Corentec's 3D printed coating
(Direct Energy Deposition 3D printing)

• Hybrid manufacturing, coating on top of machined cup allows
• Short build up time compared with commercial 3D printed coating, that is the most economical technology
Manufacturing approval certificate for Artificial Hip Joint

K F D A, US FDA and CE is on going
THANK YOU FOR YOUR ATTENTION