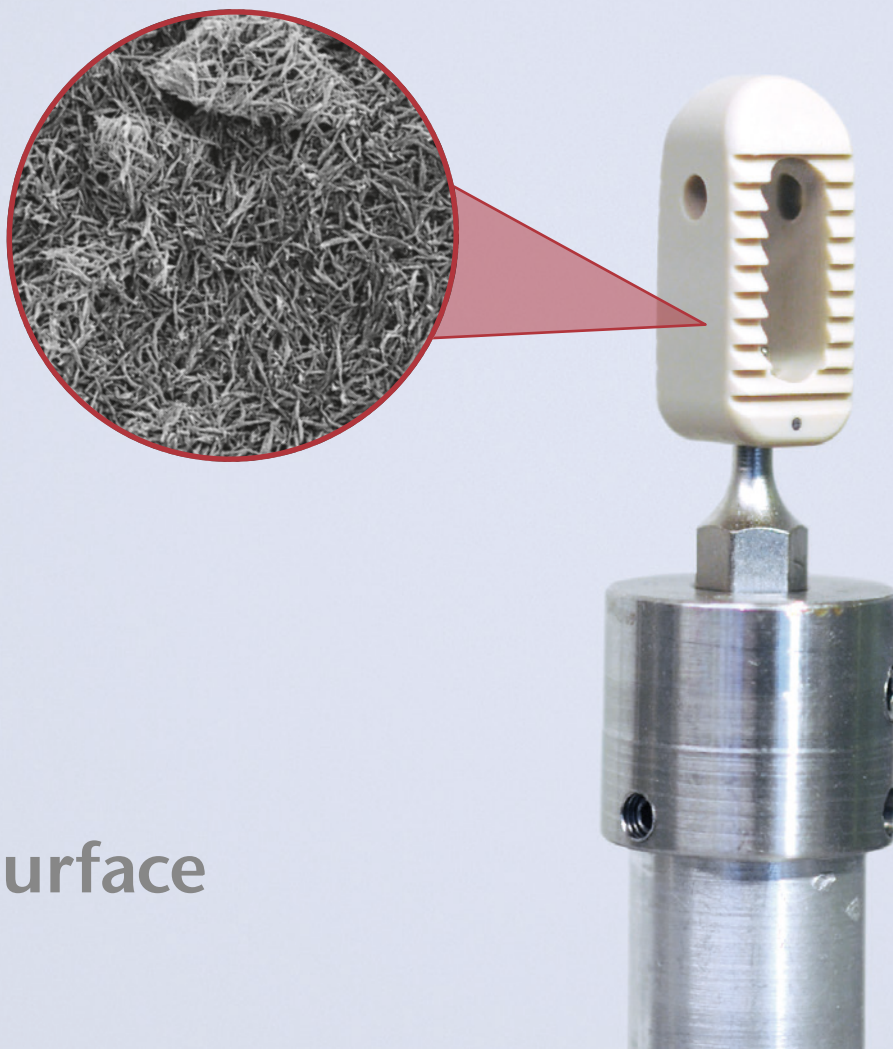
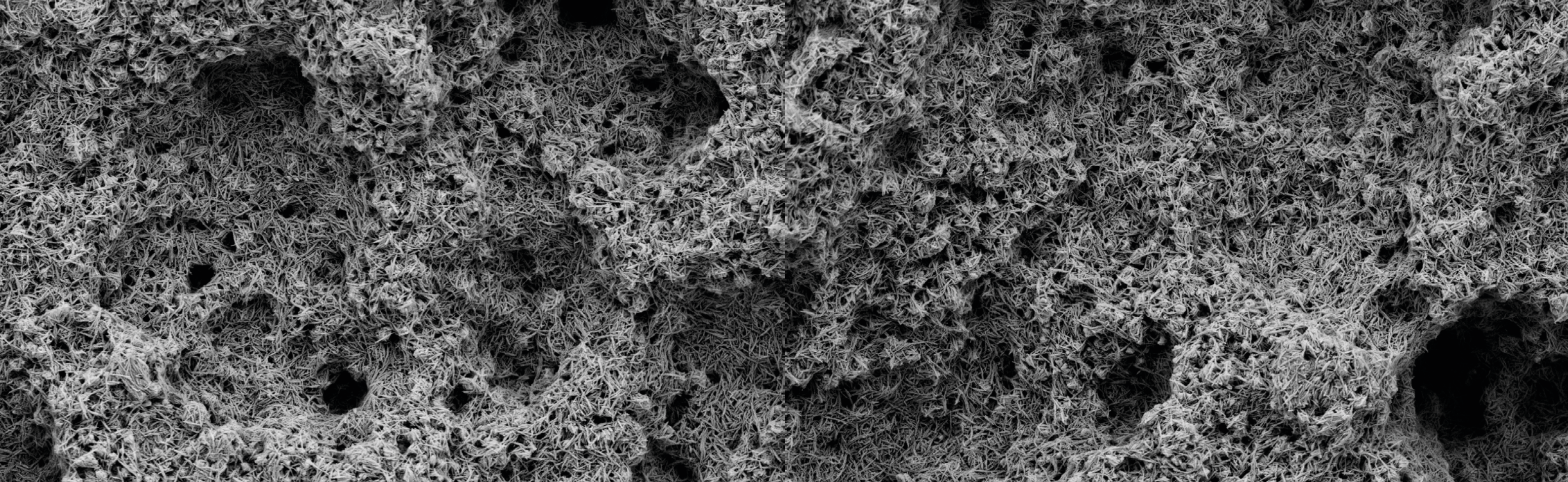


Adding a New Dimension to Osseointegration

Thinner. Faster. Stronger.



 **HA**^{nano} Surface



HA^{nano} Surface is a 20 nanometer thin surface modification for implants composed of crystalline hydroxyapatite (HA) particles that through shape, composition, and structure mimic human bone tissue. HA^{nano} Surface is used clinically and has proven to significantly accelerate and enhance osseointegration of implants. The surface can be used on all implants regardless of material and geometry.

** The image shows HA^{nano} Surface on a ceramic implant*



1 μ m

Meet the New Golden Standard of Osseointegration

Enhancing and Accelerating Bone Growth

Thinner

Nanotechnology Mimicking Nature

The mere 0.02µm thin bone-mimicking hydroxyapatite layer can be applied to both traditional implant surfaces and 3D structures.

Faster

Catalyzing Biological Response

HA^{nano} Surface improves the hydrophilicity of the implant which facilitates absorption of body fluids and catalyzes biological responses.

Stronger

Enhancing Osseointegration

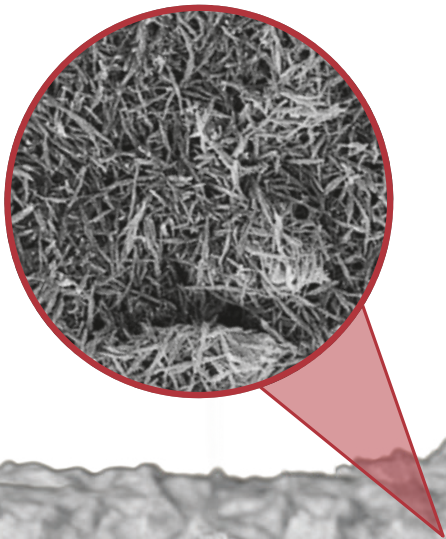
The results from more than 30 pre-clinical studies show that HA^{nano} Surface accelerates osseointegration and enhances early bone growth.

Adding a New Dimension to Osseointegration

Integration in the Nanometer Range

HA^{nano} Surface introduces a new size regime for implant coatings. The nano-thin surface enables newly formed bone to grow directly into the micrometer topography, or roughness, of the implant surface, thus providing mechanical stability.

Compared to traditional coatings, where bone anchors to the coating, HA^{nano} Surface does not act as an interface separating bone from the implant. Furthermore, with the particle based HA^{nano} Surface there is no risk for cracking or delamination, and the flexibility of the implant material is retained. In addition, since the dimensions of the implant are unchanged, there is no need for new implant designs or instruments during surgery.



HA^{nano} Surface

Traditional coating

80 µm

HA^{nano} Surface is **more than 1,000 times thinner than traditional HA coatings**, making it possible for bone to anchor directly to the implant surface.

Unique Process for Nano-Thin Surface Modifications

Excellent Adherence to Any Material, Any Structure

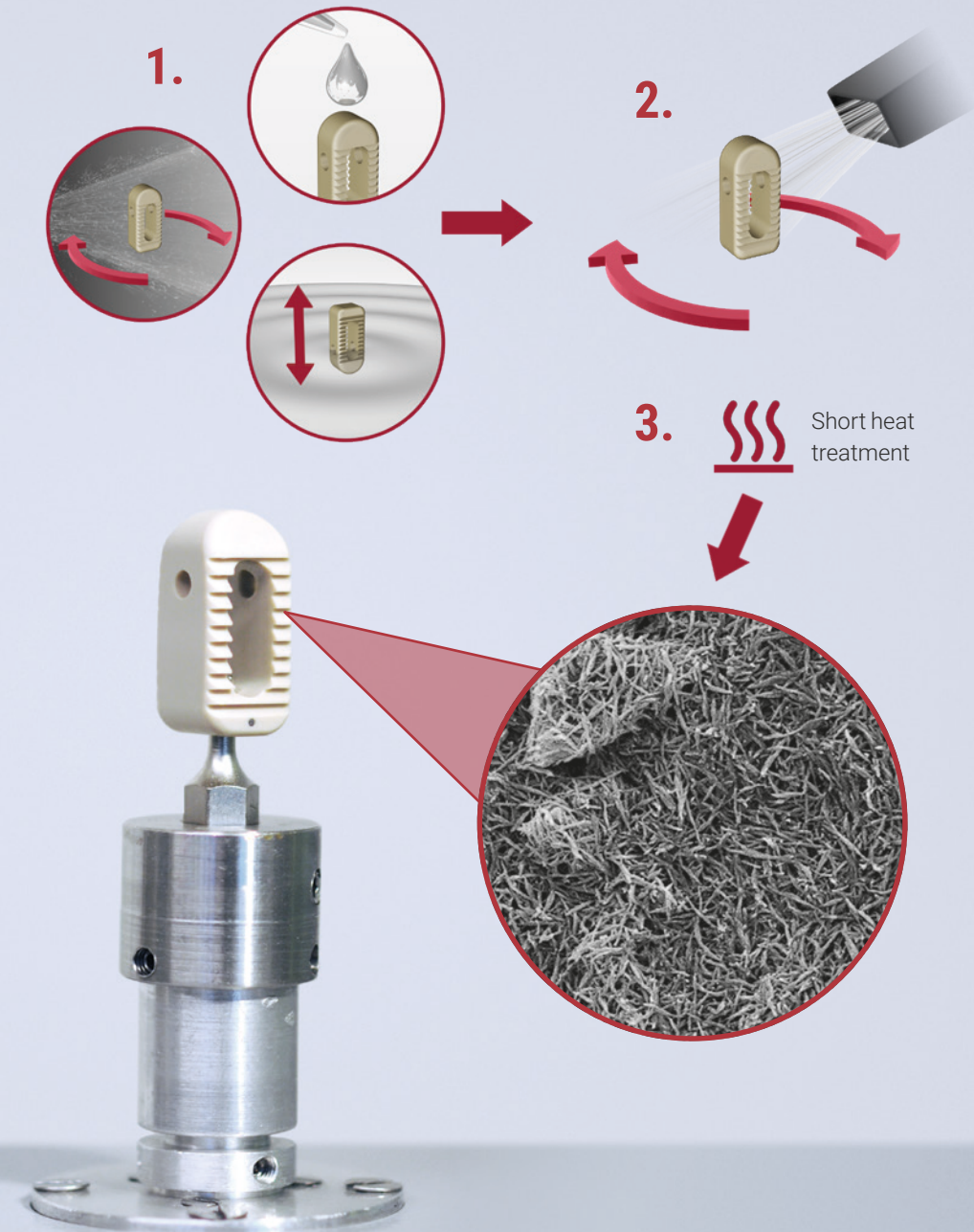
The surface modification with HA^{nano} Surface is based on a wet chemical process with no requirement of line-of-sight. Thus HA^{nano} Surface can be applied to any implant geometry, including complex and porous implants without compromising the porosity of the implant surface. The surface has excellent compatibility with all implant materials including ceramics, metals, pyrocarbon, and PEEK.

The HA^{nano} Surface process is based on off-the-shelf equipment and can easily be implemented at existing implant manufacturing lines. The modification process involves three simple steps:

1. Application of coating liquid to the implant
2. Thin film formation by removing excess coating liquid
3. Heat treatment (five minutes at temperatures significantly lower than for traditional coatings)

The result is an extremely thin layer of synthetic bone that will enhance the bone growth and create stronger anchoring of the implant.

The HA^{nano} Surface process can be integrated at the implant manufacturer's own production line. For OEMs without in-house manufacturing capabilities, Promimic has established a strategic partnership with Danco Anodizing, a leading supplier of surface treatments to the medical device industry. During 2016, an HA^{nano} Surface production line was fully implemented at Danco Anodizing's facility in Warsaw (Indiana, U.S.) and can now be offered to Promimic customers.

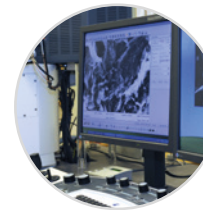




Rapid Pathway to Product Launch

From Concept to Market in 12 Month

Promimic assists you through the process from idea to market.



1. Concept Evaluation

Promimic helps you evaluate HA^{nano} Surface on your products

- Feasibility project: modification of customer samples and testing by Promimic and/or customer
- Promimic advises in regulatory affairs and production set-up



2. Development

Promimic assists your preparations for market launch

- Continued/extended testing - e.g. mechanical tests, *in vitro/in vivo* (optional)
- Regulatory filings - benefit from Promimic's extensive data portfolio
- Optimization of modification process, development of SOPs and tech-transfer



3. Commercial Phase

Promimic supports you throughout the product life cycle

- The HA^{nano} Surface process performed at customer site, Danco Anodizing, or other CMO
- Promimic provides coating liquid for production
- QC, training and technical support

Introducing Hydrophilicity to Your Implant

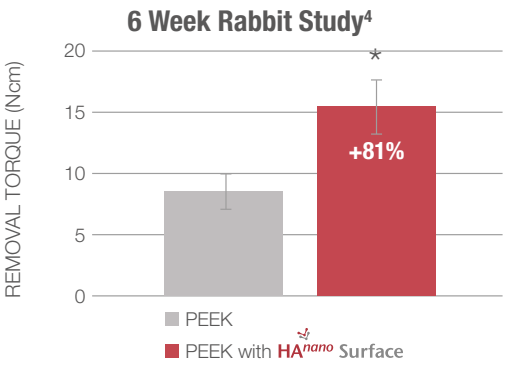
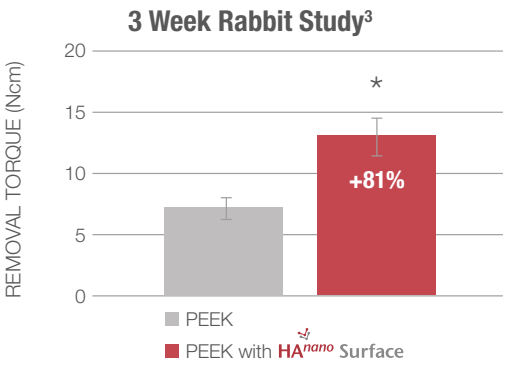
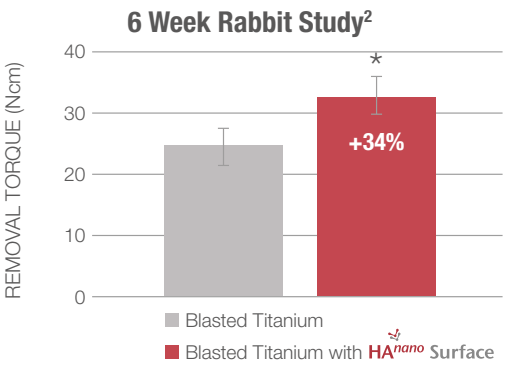
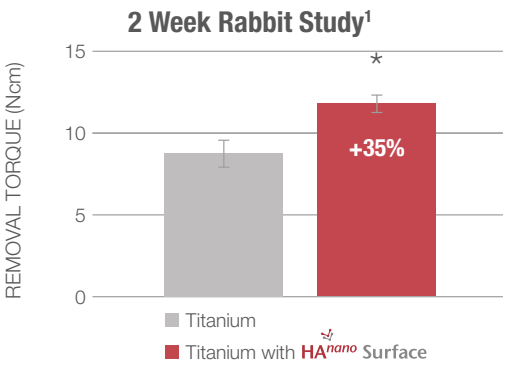
Enhancing and Accelerating Bone Growth

Adding HA^{nano} Surface to an implant catalyzes the biological response. HA^{nano} Surface has proven to accelerate osseointegration of implants and enhance early bone growth in more than 30 pre-clinical studies. The nano-thin surface modification has shown to increase the anchoring of titanium implants by up to 35% and by over 80% for PEEK implants during the first critical period of healing.

The hydrophilicity of the implant is significantly improved by applying HA^{nano} Surface. Improved hydrophilicity facilitates the absorption of body fluids into small pores and cavities on the implant surface. Thus, the nano-meter-sized hydroxyapatite particles enable increased attachment of bone cells to the implant and accelerate bone growth.



HA^{nano} Surface changes the material's wettability from hydrophobic (left) to hydrophilic (right), enabling a closer interaction with bone tissue.



Error bars represent standard error, p<0.05

1. Jimbo et al. (2011), 'Genetic Responses to Nanostructured Calcium-phosphate-coated Implants', J Dent Res, Dec;90(12):1422-7.
2. Jimbo et al. (2012), 'The biological response to three different nanostructures applied on smooth implant surfaces', Clin Oral Implants Res, Jun;23(6):706-12.
3. Johansson et al. (2014), 'Biomechanical evaluation and surface characterization of a nano-modified surface on PEEK implants: a study in the rabbit tibia', Int J Nanomedicine, Aug;9:3903-11.
4. Barkarmo et al (2014), 'Enhanced bone healing around nanohydroxyapatite-coated polyetheretherketone implants: An experimental study in rabbit bone', J Biomater Appl, Nov;29(5):737-47.

Thinner. Faster. Stronger.

Promimic is an innovative biomaterial partner developing and marketing nano-thin surface modifications for all implant materials and geometries. Promimic is specialized in nanotechnology and production of HA. With offices both in the U.S. and Europe, Promimic caters to clients in both Europe and North America.

HA^{nano} Surface is currently used clinically in tens of thousands of patients. Promimic fulfills the requirements of SS-EN ISO 13485:2012 and the process meets both FDA and CE specifications. Promimic's scientific documentation combined with the regulatory approvals in the U.S. (510(k)), EU and South America provides a clear regulatory pathway for products using HA^{nano} Surface.

What HA^{nano} Surface Can Do for Your Product

- Faster fusion for spinal titanium and PEEK IBFDs
- Enhances hydrophilicity for deeper bone in-growth of porous materials
- Improves fixation for bone screws

Preferred U.S. partner for production services: *DANCO*