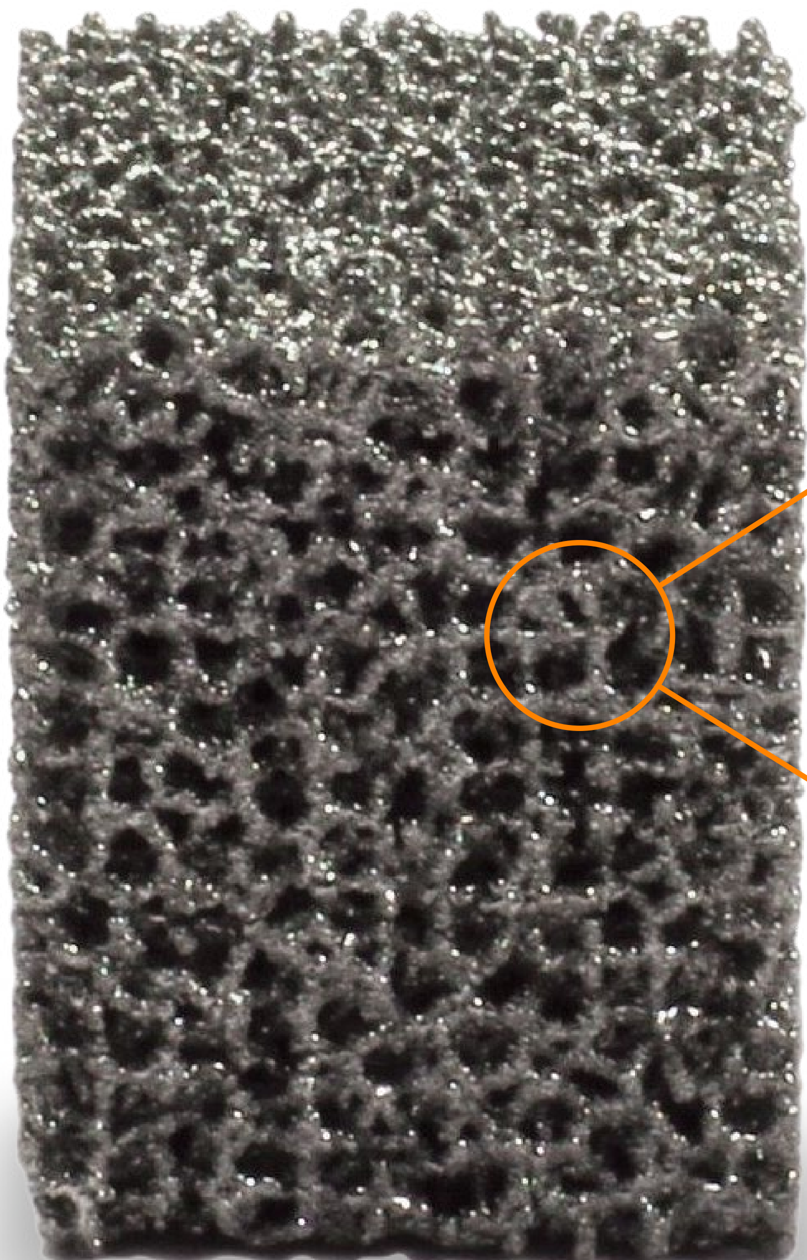
smith&nephew

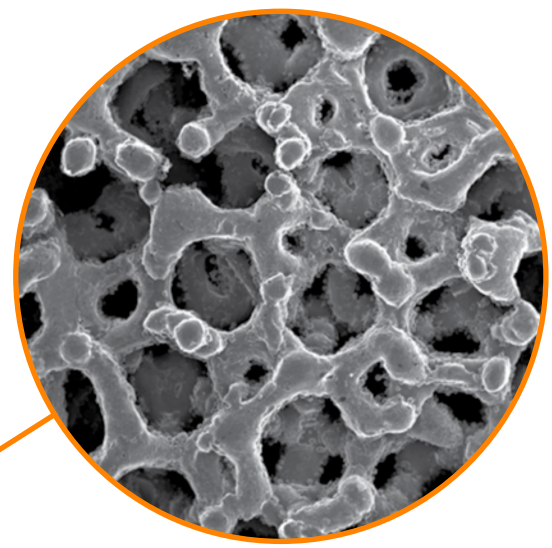
CONCELOC◊

Advanced Porous Titanium

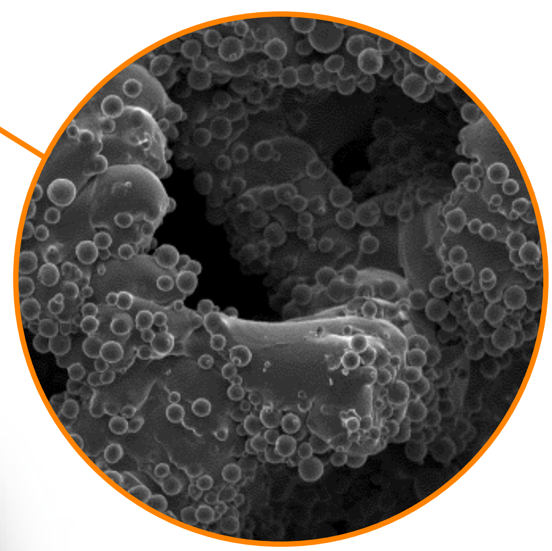
A technology from Smith & Nephew

Material specifications





CONCELOC at 25x magnification



CONCELOC at 80x magnification

CONCELOC◇ Advanced Porous Titanium

Customized, patent pending porous structure technology

Through our pioneering approach to design, Smith & Nephew engineers have developed a patented method for creating a fully randomized porous structure with predictable porosity, pore size and node interconnectivity. Devices incorporating the patented CONCELOC Advanced Porous Titanium are created in a virtual environment and then fabricated at Smith & Nephew via additive manufacturing.

Design flexibility

Additive manufacturing (AM), commonly referred to as 3D printing, is a novel manufacturing method that involves the use of a laser or electron beam, for example, to sinter polymer or metal powders into a solid part that is built layer-by-layer. This unique fabrication method provides greater design flexibility compared to standard, subtractive manufacturing, i.e., machining. AM has also enabled Smith & Nephew to develop this custom porous structure for biological fixation combined with complex device geometries that would be difficult, expensive or impossible to attain through conventional fabrication methods. This design flexibility was leveraged to produce a roughened texture that is mapped onto the bone-interfacing surfaces of the virtual models to provide friction for enhanced initial stability. Furthermore, solid reinforcements can be added as an integral part of the porous structure where desired since both solid and porous features are fabricated layer-by-layer at the same time.

Material composition: Titanium Alloy (Ti-6Al-4V)

CONCELOC is made from Ti-6Al-4V and meets the ASTM and ISO standards for that alloy, which has been shown to be biocompatible[1] and has a good clinical history with over 40 years of use in medical devices.[1]

Porosity: Up to 80%

CONCELOC Advanced Porous Titanium has an interconnected network of pores with a porosity of up to 80% in the near-surface regions, where the initial fixation will occur, and an overall porosity up to about 67%.[2]

Pore size: 202µm to 934µm

The literature suggests that pore sizes greater than about 100µm benefit biological fixation.[3,4] CONCELOC Advanced Porous Titanium has an average pore size that ranges from 202 to 342µm overall and from 484 to 934µm at the surfaces of the porous structure.[2,5]

Mechanical properties*

Compressive modulus (GPa)

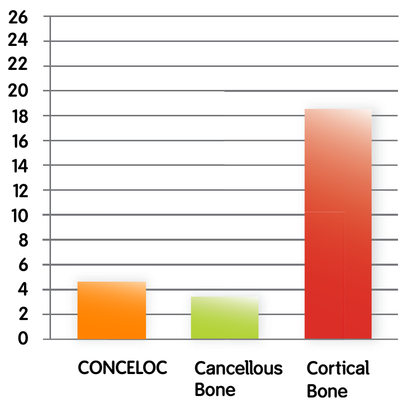


Figure 1: Plot illustrating the compressive modulus measured for the CONCELOC® Advanced Porous Technology[6] compared to values reported for cancellous[7] and cortical[4,8] bone.

Compressive 2% yield strength (MPa)

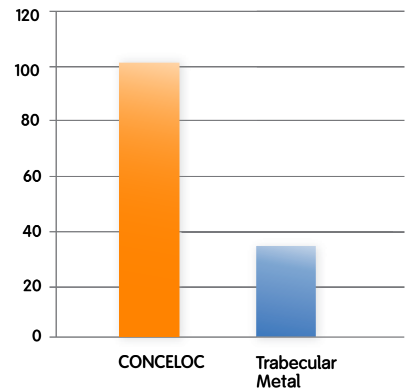


Figure 2: Plot illustrating the compressive yield strength of the CONCELOC Advanced Porous Technology[9] compared to that reported for Trabecular Metal.[10]

Compressive fatigue strength (MPa)

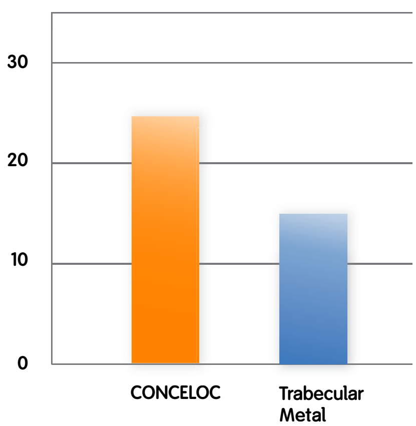


Figure 3: Plot illustrating the compressive fatigue strength of the CONCELOC Advanced Porous Technology[11] compared to that reported for Trabecular Metal.[10]

Coefficient of friction

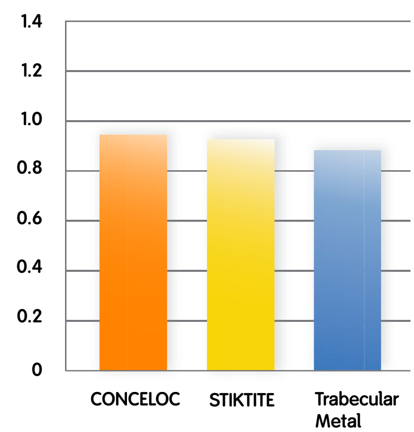


Figure 4: Plot illustrating the coefficient of friction of CONCELOC Advanced Porous Technology[12] compared to that reported for STIKTITE[12] porous coating and Trabecular Metal.[13]

The CONCELOC and STIKTITE porous structures were tested against 10 lb/ft^3 (0.16 g/cm^3) foam. The test method for these porous structures differed from that used for Trabecular Metal.

Material properties*

	CONCELOC	STIKTITE	Trabecular Metal	Tritanium	Regenerex	Gription
Material	Titanium Alloy	Titanium Alloy	Tantalum[14]	CP Titanium[15]	Titanium Alloy[16]	CP Titanium[17]
Modulus of Elasticity	4.3 GPa[6]	113 GPa**[18]	1.3-3.9 GPa[10,19]	113 GPa**[18]	1.9 GPa[16]	113 GPa**[18]
Compressive 2% Yield Stress	101.2 MPa[9]	N/A	36.9 MPa[10]	N/A	N/A	N/A
Porosity	Up to 80%[2]	62%[20]	80%[14]	72%[21]	67%[16]	63%[22]
Pore Size (Ave)	202-934µm[2,5]	194µm[20]	430µm[13]	311-546µm[21]	100-600µm[16]	300µm[22]
Coefficient of Friction	0.95[12]	0.93[12]	0.88[13]	1.01[21]	N/A	1.2[17]
Porous Matrix or Coating	Porous Matrix	Coating	Porous Matrix	Both	Both	Coating

* Data for competitive porous structures was obtained from the referenced literature with test methods that differ between porous structures. Data is tabulated for general comparisons only.

**Ti-6Al-4V substrate with coating.

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