
ECiMa™
Vitamin E technology
Locking in Life*
Corin
Responsible Innovation

ECiMa™

Advances in material and manufacturing technologies have attempted to address current issues with ultra high molecular weight polyethylene (UHMWPE) such as wear, fracture and mid-term oxidation[1]. However challenges remain in relation to long-term oxidation and material strength[2,3,4]. ECiMa™ vitamin E highly cross-linked polyethylene (HXLPE) has been developed in conjunction with Massachusetts General Hospital, Boston, to address some of these long-standing clinical issues, and is designed to provide an advanced, high performance, oxidation resistant bearing technology, locking in the life of the polyethylene through the incorporation of vitamin E.

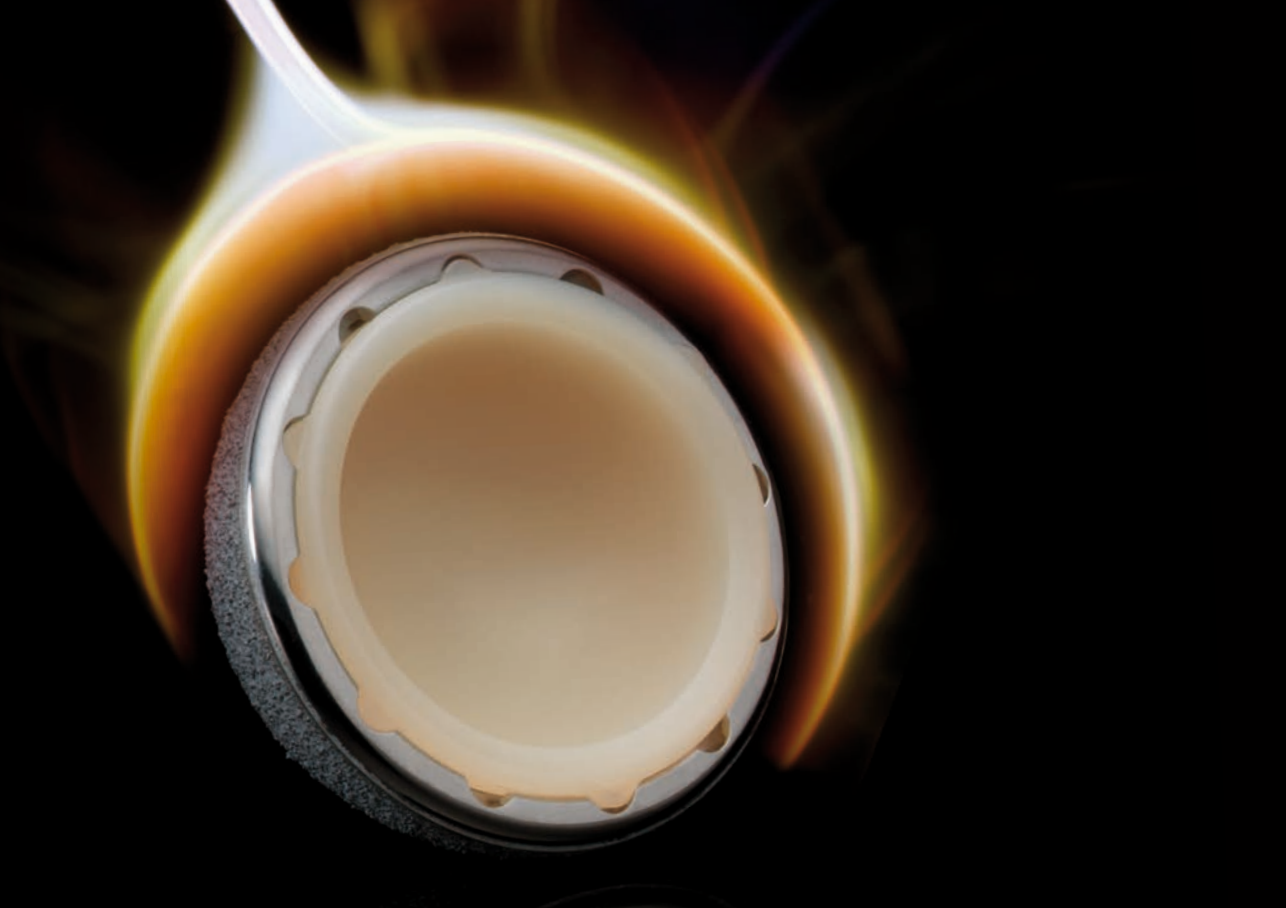
not all polyethylenes are **equal**

ECiMa™ uses a proprietary blending and consolidation process, grafting the vitamin E to the polyethylene molecule at the start of the manufacturing process. This allows uniform distribution of vitamin E, minimising the elution effect seen in diffused or doped vitamin E products.

E — Locking out **Oxidation**
Vitamin **E** incorporated

Ci — Locking out **Wear**
Cold gamma **i**rradiated

Ma — Locking in **Strength**
Mechanically **a**nnealed HXLPE

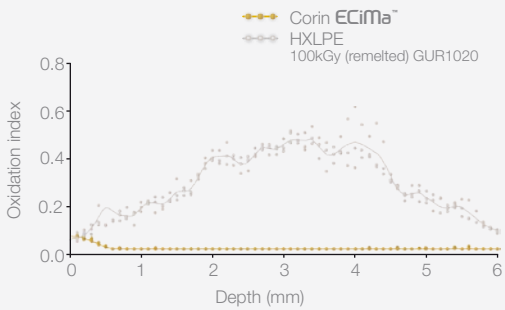


ECiMa™

Locking out **Oxidation**

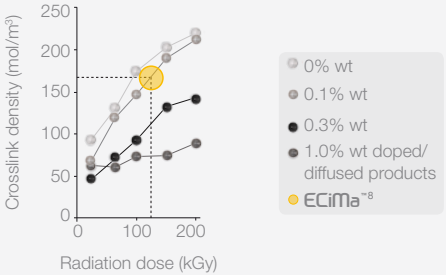
Whilst first generation highly cross-linked polyethylenes were designed to minimise oxidation, recent research has demonstrated that cyclic loading and absorption of lipids such as squalene results in the generation of free radicals *in vivo,* causing oxidation[5,6]. The vitamin E grafted to the polyethylene acts as a reservoir able to quench free radicals, minimising the potential for *in vivo* oxidation[7].

Oxidation (absorbance/depth mm)[8]



ECiMa™ tests have shown no evidence of oxidation following intensive ageing and cyclic loading where previous HXLPE liners have been shown to fail[8].

Radiation and vitamin E optimisation[9]



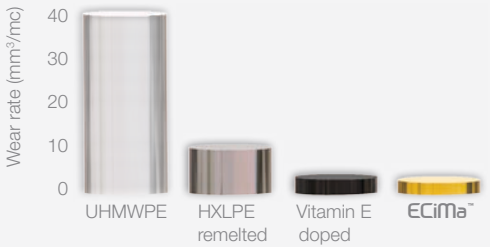
The radiation dose and vitamin E content have been optimised with ECiMa™, providing improved cross-link density for the radiation dose. In comparison, conventional infused vitamin E polyethylenes use up to 1% weight vitamin E which yields a lower cross-link density and poorer wear properties for a given radiation dose.

Locking out **Wear**

A proprietary mechanical annealing process combined with low vitamin E dosage allows optimisation of cross-linking density, improving the wear resistance of ECiMa™ over conventional HXLPE and infused vitamin E products.

- 41% reduction compared to infused vitamin E products[10]
- 83% reduction compared to HXLPE[11]
- 95% reduction compared to UHMWPE[11]

Wear rate[10,11]

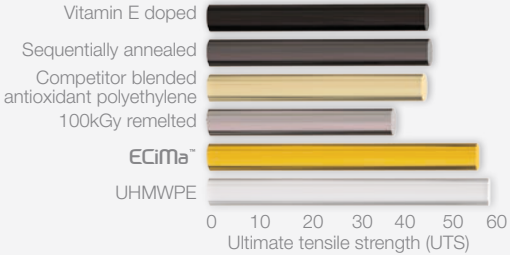


Locking in **Strength**

Unlike most other antioxidant and HXLPE materials, ECiMa™ utilises a mechanical annealing process which quenches free radicals below melt temperature, maintaining the mechanical integrity of the material[12,13].

- 45% increase in ultimate tensile strength compared with conventional HXLPE[11]
- 17% increase in ultimate tensile strength compared with modern generation antioxidant and sequentially annealed HXLPE[10]

Mechanical integrity vs competitor products[10,14,15]



References:

1. Muratoglu OK, Kurtz S. Alternate bearing surfaces in hip replacement: Sinha R, editor. Hip replacement. Current trends and controversies. New York, 2002.
2. Kurtz SM, Hozack WJ, Purtill JJ, Marcolongo M, Kraay MJ, Goldberg VM, et al. Significance of in vivo degradation for polyethylene in total hip arthroplasty. Clin Orthop Relat Res, 2006;453:47e57.
3. Wannomae K, Bhattacharyya S, Freiberg A, Estok D, Harris W, Muratoglu O. In vivo oxidation of retrieved crosslinked UHMWPE acetabular components with residual free radicals. *J Arthroplasty*, 2006;21(7):1005e11.
4. Currier BH, Currier JH, Mayor MB, Lyford K, Collier JP, Van Citters DW. Evaluation of oxidation and fatigue damage of retrieved crossfire polyethylene acetabular cups. *J Bone Joint Surg*, 2007;89A:2023e9.
5. Reintz SD Currier BH, Van Citters DW, Levine RA, Collier JP. Oxidation and other property changes of retrieved sequentially annealed UHMWPE acetabular and tibial bearings. *J Biomed Mater Res B Appl Biomater.* 2014 June 23
6. MacDonald D, Sakona A, Ianuzzi A, Rimnac CM, Kurtz SM. Do first-generation highly crosslinked polyethylenes oxidize in vivo?. Clin Orthop Relat Res. 2011 Aug;469(8):2278-85.
7. Rowell SL, Micheli BR, Wannomae KK, Malchau H, Muratoglu OK. In Vivo Performance of Highly Cross-linked UHMWPE. Presented 5th UHMWPE meeting USA 2010
8. Data held on file. Corin Group PLC.
9. Oral E, Godleski Beckos C, Malhi AS, Muratoglu OK. The effects of high dose irradiation on the crosslinking of vitamin E-blended ultra high molecular weight polyethylene. Biomaterials. 2008;29:3557-60.
10. Competitor literature review.
11. Traynor A, Simpson D, Collins S. ECiMa™ for low wear, optimal mechanical properties and oxidation resistance of hip bearings. Total Hip Arthroplasty – Wear Behaviour of Different Articulations, EFORT Reference in Orthopaedics and Traumatology, Springer: ISBN 978-3-642-27360-5, 2012.
12. Oral E, Wannomae KK, Hawkins NE, Harris WH, Muratoglu OK. a-Tocopherol doped irradiated UHMWPE for high fatigue resistance and low wear. Biomaterials, 2004;25(24):5515–22.
13. Oral E, Christensen S, Malhi A, Wannomae K, Muratoglu O. Wear resistance and mechanical properties of highly crosslinked UHMWPE doped with vitamin E. *Journal of Arthroplasty*, 2006;21(4):580–91.
14. Greer, K.W. and M.S. Sharpe. "Comparison of Cross-linked UHMWPE Stabilized by Sequential Annealing or by Remelting." Poster 1784, 53rd Annual Meeting of the Orthopaedic Research Society, February 11-14, 2007, San Diego, CA.
15. Muratoglu OK, Burrough BR, Malhi A, Christensen S, Wannomac K, Oral E, Spiegelberg S and Harris WH. "Two Second Generation Cross-linked UHMWPES Show Improves Mechanical Properties and Fatigue Strength." Poster No. 1661, Presented at the 51st Annual Meeting of the Orthopaedic Research Society, Washington, DC.

***Locking in the life of the polyethylene through the incorporation of vitamin E to prevent oxidation and minimise wear[8]**

Corin

www.coringroup.com