PyroCarbon Implants
Durability + Biocompatibility
PyroCarbon is a specific form of carbon that has been tailored for durability and biocompatibility. PyroCarbon exhibits favorable wear characteristics and fatigue endurance. PyroCarbon should not be confused with carbon fibers, which are minute particles used to strengthen other materials.

Manufacturing a PyroCarbon implant begins with a precision-machined graphite substrate that contains 1 atomic percent tungsten to make the core visible on X-ray. Using patented steady-state process controls, a thick layer of radiolucent On-X® pure carbon is deposited onto the graphite core, ensuring strength and durability.
Integra is a world leader in PyroCarbon implants. Over 50,000 have been implanted worldwide.

Patented On-X® PyroCarbon has been shown to be a favorable material for orthopedic applications with advantages over metallic alloys and polymers as it demonstrates:

- Favorable wear characteristics
- Modulus of elasticity that is similar to cortical bone
- Compatible with joint cartilage and bone
- Non-cemented fixation by bone apposition

Uniform lucent line represents radiolucent PyroCarbon coating. Sclerotic bone formation adjacent to lucent line demonstrates appositional bone growth, encasing PyroCarbon implant.
Wear Comparison:
PyroCarbon on PyroCarbon vs. Cobalt Chrome on Ultra High Molecular Weight Polyethylene (UHMWPE)\(^1\)

This graph depicts the wear characteristics of a PyroCarbon ball and socket implant compared to CoCr/UHMWPE ball and socket implant in vitro. All test specimens were subjected to a 14 lb. axial load and taken through 90° ROM for 10,000,000 cycles.

PyroCarbon is highly wear resistant and is a favorable material for orthopedic implants compared to metallic alloys and polymers.


PyroCarbon is Durable

Near Natural Wear Characteristics

Natural joints have been shown to lubricate through the adsorption of surfactants surface-active phospholipids (SAPL) to cartilage which provides boundary layer lubrication and a reduction in friction. PyroCarbon surfaces offer the potential for boundary layer lubrication and a low coefficient of friction through the same mechanism.\(^5\)

In laboratory tests, PyroCarbon performed superior to other prosthetic materials in its ability to attract SAPL.\(^5\) This may contribute to favorable wear characteristics in hemiarthroplasty applications.

PyroCarbon NuGrip™ CMC
PyroCarbon Lunate
PyroCarbon is Bone Friendly

The elastic modulus of PyroCarbon is similar to cortical bone resulting in biomechanical compatibility with bone. Unlike surgical grade metals, PyroCarbon transfers load from implant to bone more effectively, thus reducing stress shielding and potential bone resorption.1,6

Elastic Modulus (GPa)

<table>
<thead>
<tr>
<th>Material</th>
<th>Elastic Modulus (GPa)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cortical Bone</td>
<td>15.2-40.8</td>
</tr>
<tr>
<td>PyroCarbon</td>
<td>29.4</td>
</tr>
<tr>
<td>Titanium Alloy</td>
<td>116</td>
</tr>
<tr>
<td>Zirconia</td>
<td>201</td>
</tr>
<tr>
<td>CoCr Alloys</td>
<td>200-300</td>
</tr>
</tbody>
</table>

Elastic modulus of metal and ceramic are much greater than that of bone or PyroCarbon.

After cyclical testing to 5,000,000 cycles, PyroCarbon demonstrated minimal wear into cortical bone**. The other materials exhibited extensive bone wear at 375,000 cycles with Cobalt Chrome, 50,000 - 75,000 cycles with Titanium and 25,000 cycles with Zirconia.7

* One of four CoCr samples survived for 5,000,000 cycles
** Laboratory testing on bovine bone
PyroCarbon is Cartilage Friendly

PyroCarbon has been shown to be much less damaging to native cartilage and bone joint tissues than metal alloys. PyroCarbon’s low surface friction and nonadhesive properties may contribute to preserving cartilage. PyroCarbon offers the ability to extend the functional life of these joints and thus transform extremity hemiarthroplasty.

Cartilage Survival

A study of cartilage wear in 45 canine acetabula was performed using both PyroCarbon and metal alloy hip prostheses. PyroCarbon showed remarkably less wear damage to cartilage. After 18 months, cartilage articulating with PyroCarbon exhibited a 92% survivorship probability compared to a 20% cartilage survivorship with metallic alloys.²
Decades of biomedical research and clinical outcomes demonstrate that PyroCarbon is a durable and biocompatible material. Integra continues to limit uncertainty with research and development of new applications of PyroCarbon technology for extremity surgery.

PyroCarbon Cementless Fixation

PyroCarbon has a micro-porous structure that enhances bone fixation without the need for cement. This fixation is achieved initially through a press fit design using specially designed instrumentation. Long term fixation is achieved via appositional bone growth as bone remolds up to the bone-friendly surface of PyroCarbon.¹

Scanning Electron Micrograph showing the micro-porous structure of the PyroCarbon surface (5000X magnification).
References


For more information or to place an order, please contact:
Integra • 311 Enterprise Drive, Plainsboro, NJ 08536
800-997-4868 USA • 609-936-5400 outside USA • 888-980-7742 fax
integralife.com