Redefining precision laser optics
<table>
<thead>
<tr>
<th>Year</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>Confirmation of the low mechanical loss of GaAs/AlGaAs multilayers</td>
</tr>
<tr>
<td>2012</td>
<td>Crystalline Mirror Solutions OG founded as spin-off of the University of Vienna and the Vienna Center for Quantum Science and Technology (VCQ)</td>
</tr>
<tr>
<td>2012</td>
<td>Pre-Seed financing by the Austria Wirtschaftsservice (aws)</td>
</tr>
<tr>
<td>2013</td>
<td>Crystalline Mirror Solutions OG transitions to CMS GmbH</td>
</tr>
<tr>
<td>2013</td>
<td>Crystalline Mirror Solutions LLC founded in Santa Barbara, CA</td>
</tr>
<tr>
<td>2013</td>
<td>Publication of “Tenfold reduction of Brownian noise in high-reflectivity optical coatings” in Nature Photonics</td>
</tr>
<tr>
<td>2013</td>
<td>Seed financing by the Austria Wirtschaftsservice (aws)</td>
</tr>
<tr>
<td>2014</td>
<td>CMS reaches the finals of the Houska Prize (B&amp;C Privatstiftung)</td>
</tr>
<tr>
<td>2014</td>
<td>CMS reaches the finals (Top 5) in the category of IKT/Technology of the Mercur Innovation Award 2014 (Vienna Chamber of Commerce)</td>
</tr>
<tr>
<td>2014</td>
<td>CMS reaches the semi-finals of the “SPIE Startup Challenge” of the Photonics West Conference in San Francisco, USA.</td>
</tr>
<tr>
<td>2014</td>
<td>CMS wins the GEWINN Young Entrepreneurs Award 2014 [category: High-Tech] supported by the BMWF</td>
</tr>
<tr>
<td>2015</td>
<td>CMS wins the 2015 “Young Enterprise Award” of the AMA Association for Sensors and Measurement (Germany)</td>
</tr>
<tr>
<td>2015</td>
<td>CMS wins the 2015 Vienna Startup Award</td>
</tr>
<tr>
<td>2015</td>
<td>CMS wins the 2015 Born Global Champion Award</td>
</tr>
</tbody>
</table>
SINGLE-CRYSTAL COATINGS ARE THE KEY

Crystalline Mirror Solutions manufactures low-noise reflective optics using a proprietary coating technology. High-performance optical coatings are critical for a variety of scientific endeavors and commercial industries, including broadband communication, navigation, and sensing.

Our crystalline coatings represent an entirely new paradigm in optical coating technology, impacting cavity end mirrors for state-of-the-art ultrastable lasers, cavity-ringdown systems, and ring-laser gyroscopes.

Moreover, exploiting the high thermal conductivity and active electro-optic properties of the materials we employ, crystalline coatings promise to have a tremendous impact in ultra-fast and high-power laser systems.
REDUCTION OF BROWNIAN NOISE

Crystalline coatings enable a $10-100 \times$ reduction in mechanical dissipation. CMS has developed a new "Crystalline Supermirror" technology, which addresses the technical limitations of excess thermal noise in sputtered coatings.

Due to the unique properties of our semiconductor coating material, our Crystalline Supermirrors provide a $10-100 \times$ reduction in mechanical dissipation, and thus corresponding reductions in Brownian noise, when compared with typical ion-beam sputtered films. Furthermore, this unique mirror technology exhibits additional advantages such as very low optical losses in the mid-infrared and high thermal conductivity, more than $50 \times$ greater than competing dielectric mirror technologies.

---

SUBSTRATE-TRANSFER AND BONDING PROCESS

Building upon earlier work in high-performance AlGaAs-based optomechanical resonators, CMS has developed a groundbreaking coating technology that enables the transfer of monocrystalline multilayers onto essentially arbitrary (including curved) substrates. Based on this technique, we are able to bond single-crystal GaAs/AlGaAs semiconductor multilayers on a large variety of substrate materials including fused silica, sapphire, Si, SiC, diamond, and YAG.
MONOCRystALLINE SEMICONDUCTOR MIRROR SYSTEMS

- Low thermal noise
- High IR reflectivity
- High thermal conductivity

While AlGaAs-based distributed Bragg reflectors (DBRs) have been applied for the fabrication of optical interference coatings since the late 1970s, until the development of our substrate-transfer technology, these materials had not been employed as general optical coatings. With the ability to transfer AlGaAs onto arbitrary substrates, we can now generate ultrastable mirrors with low Brownian noise, high reflectivity MIR mirrors, and high thermal conductivity active and passive mirror systems.
PRODUKTE

_xtal stable_
xtal stable technology for
- Sub-Hz linewidth lasers
- Ring laser gyroscopes
- Laser ranging / LIDAR systems

_xtal mir_
xtal mir technology for
- Trace gas detection
- Power buildup cavities
- Novel laser system design

_xtal therm_
xtal therm technology for
- Ultrafast and high-power lasers
- High thermal conductivity reflectors
- Advanced optics for machining
LEADERSHIP

Univ.-Prof. Dr. Markus Aspelmeyer
Co-Founder, President of the Supervisory Board

Dr. Christian Pawlu
CEO

Dr. Garrett Cole
Co-Founder, CTO
Crystalline Mirror Solutions GmbH  
Seestadtstraße 27, Top 1.05,  
A-1220 Vienna, Austria, +43 1 931 34 32 55

Crystalline Mirror Solutions LLC  
114 E Haley, Suite N, Santa Barbara,  
CA 93101 USA, +1 805-899-1711

info@crystallinemirrors.com
www.crystallinemirrors.com