Reaction Bonded Silicon Carbide

II-VI Infrared, the high power CO2 and Fiber laser solution center is once again bringing you the next generation of high power laser optical materials. In collaboration with our wholly owned subsidiary M Cubed Technologies, II-VI is working to develop materials tailored for the future of high power laser processing. Engineered materials such as Reaction Bonded SiC (RB SiC) and Reaction Bonded SiC + Diamond (RB SiC + Diamond) combine all of the best material properties of traditional mirror materials into one optimized material solution.

Advantages of RB SiC over traditional high power mirror materials:

- Coefficient of thermal expansion 5x lower than copper reduces the deformation of the optical surface due to the thermal load.
- Density 3x lower than copper reduces the weight of the mirror and allows for use in cutting heads that require fast movement of the head.
- Ability to add internal water cooling channels gives it an advantage over Si mirrors.
- Ability to directly polish with roughness < 40Å and coated with any II-VI high reflector coating.

<table>
<thead>
<tr>
<th>Material</th>
<th>Density (g/cc)</th>
<th>Young's Modulus (GPa)</th>
<th>Thermal Cond. (W/mK)</th>
<th>CTE (ppm/K at RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB SiC</td>
<td>2.95</td>
<td>344</td>
<td>151</td>
<td>2.9</td>
</tr>
<tr>
<td>Copper</td>
<td>8.96</td>
<td>117</td>
<td>390</td>
<td>16.7</td>
</tr>
<tr>
<td>Silicon</td>
<td>2.33</td>
<td>131</td>
<td>156</td>
<td>2.6</td>
</tr>
<tr>
<td>Aluminum</td>
<td>2.7</td>
<td>69</td>
<td>167</td>
<td>22.5</td>
</tr>
</tbody>
</table>

Material properties of RB SiC vs. standard mirror materials

Reaction Bonded SiC + Diamond

If even greater thermal load handling capability is required RB SiC + Diamond could be the answer. With a CTE similar to CVD Diamond and a Thermal Conductivity greater than any traditional metal substrate SiC + Diamond is the ideal material for high thermal loads.
Advantages of RB SiC + Diamond:

- Potential to achieve a coefficient of thermal expansion nearly 1.4x superior to copper with a thermal conductivity that is 1.6x higher.
- Ability to create internal water cooling structures similar to RB SiC.
- Ability to directly polish with roughness < 40Å and coated with any II-VI high reflector coating.

<table>
<thead>
<tr>
<th>Formulation</th>
<th>Density (g/cc)</th>
<th>Young’s Modulus (GPa)</th>
<th>Thermal Cond. (W/mK)</th>
<th>CTE (ppm/K at RT)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RB SiC</td>
<td>2.96</td>
<td>344</td>
<td>151</td>
<td>2.9</td>
</tr>
<tr>
<td>RB SiC + Diamond -1.8</td>
<td>3.17</td>
<td>485</td>
<td>280</td>
<td>1.8</td>
</tr>
<tr>
<td>RB SiC + Diamond -1.5</td>
<td>3.23</td>
<td>545</td>
<td>430</td>
<td>1.5</td>
</tr>
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<td>RB SiC + Diamond -1.2</td>
<td>3.33</td>
<td>700</td>
<td>620</td>
<td>1.2</td>
</tr>
</tbody>
</table>

Material properties of Reaction Bonded SiC + Diamond

Applications for RB SiC and SiC + Diamond:

- SiC Galvo Mirrors for high end laser scanning heads.
- Mirror substrates for applications which require high thermal load handling capability.
- Heat Sinks for thermal management components.
- Ability to apply a diamond film for high end laser applications.
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