Supporting Information for

Silicon Hyperuniform Photonic Materials with a Pronounced Gap in the Shortwave Infrared.

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1. Thermogravimetric analysis of the polymer photoresist.

![Figure SI-1](http://doc.rero.ch)

**Figure SI-1** Thermogravimetric analysis of the UV-cured IP-Dip photoresist under inter (N₂) atmosphere. Solid line: Temperature. Symbols: relative weight in per cent.

2. Electron micrograph of pure TiO₂ network structure

![Figure SI-2](http://doc.rero.ch)

**Figure SI-2.** Scanning electron microscopy of a TiO₂ network structure h=6µm obtained after high temperature vacuum annealing of the TiO₂ coated polymer structure without addition of the Disilane precursor (for details see experimental section). The short axis of the cylindrical rods (in plane) is approximately 130-150nm and therefore (D)~220 – 250nm for an aspect ratio of 2.8.
3. **Electron micrograph of the entire sample before and after infiltration**

![electron micrograph](http://doc.rero.ch)

**Figure SI-3.** Left: Scanning electron microscopy of a typical polymer template h=6μm stabilized by a massive rectangular wall. Right: Same type of structure after the final silicon infiltration step (infiltration time 9 min). The images reveal the high quality of the material. The polymer template, including the massive wall, has been (almost) entirely degraded during the thermal treatment prior to the 480°C silicon CVD while the hyperuniform network structure in silicon is perfectly retained. Electron micrographs are shown at the same magnification and the scale bar is 10μm in both cases.

4. **Elemental analysis of Si-TiO\(_2\) HU structure.**

Energy Dispersive Spectroscopy (EDS) on Silicon coated TiO\(_2\) hyperuniform (HU) structures confirms the presence of TiO\(_2\) and Si. The spectrum (Figure S3) recorded from a FIB cross-section highlights the presence of Si atoms as well as Ti and O atoms. Calcium and fluoride atoms arise from the glass substrate and a contamination with gallium is noticed during the FIB cross-section process. The quantitative values shown in Table S1 permit to verify the formation of TiO\(_2\) and Si during the different steps. Indeed, the atomic percentage of O being approximately twice that of Ti is coherent with the presence of TiO\(_2\). The excess of O atoms can be attributed to adsorption or slight Si surface oxidation when the structure is exposed to air, which should not exceed 1-2 %. In order to avoid charging effects, graphite bridges were formed close to the structure to the sample holder. The observed carbon can thus be attributed to the graphite deposited for the SEM observation and to contamination in air but could also be partially due to residual carbonized polymer.

From the weight fraction of Ti and O (18.37%) and Si (44.7%) we can estimate the volume fraction of the TiO\(_2\) core in the Si coated rods. The mass density of amorphous silicon is 2.32 g/cm\(^3\) and the reference value for bulk TiO\(_2\) is 4.26g/cm\(^3\), however in the literature values for amorphous and crystalline TiO\(_2\) can be found between 2.9 and 3.9 g/cm\(^3\). We thus estimate
the volume fraction of the TiO$_2$ in the rods, after 9 min of Si infiltration, to be in the range of 22-33%. The latter is consistent with a TiO$_2$ volume fraction of $\phi_0\sim4\%$ and a total volume filling fraction of $\phi\sim15\%$.

![Figure SI-4. EDS spectra of Si-TiO$_2$ HU structure, recorded from the cross-section shown in the SEM image in inset.](http://doc.rero.ch)

<table>
<thead>
<tr>
<th>Element</th>
<th>Atomic (%)</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carbon (K)</td>
<td>22.95</td>
<td>10.20</td>
</tr>
<tr>
<td>Oxygen (K)</td>
<td>13.49</td>
<td>7.98</td>
</tr>
<tr>
<td>Titanium (K)</td>
<td>5.87</td>
<td>10.39</td>
</tr>
<tr>
<td>Silicon (K)</td>
<td>43.03</td>
<td>44.70</td>
</tr>
<tr>
<td>Fluoride (K)</td>
<td>2.32</td>
<td>1.63</td>
</tr>
<tr>
<td>Calcium (K)</td>
<td>6.15</td>
<td>9.11</td>
</tr>
<tr>
<td>Gallium (L)</td>
<td>6.20</td>
<td>15.98</td>
</tr>
<tr>
<td>Total</td>
<td>100.00</td>
<td>100.00</td>
</tr>
</tbody>
</table>

The energy-level shell used for the analysis is indicated in brackets close to each element.

5. **Infrared spectroscopy study of the sample at different fabrication stages**

In Figure S4, taken from the polymer template, typical vibration bands of the polymer functional groups are visible (dark grey line). After TiO$_2$ ALD, the same characteristic signature of the polymer is observed, (light grey line), while after Si CVD (black line) all these bands are disappeared. Indeed, at the Si deposition temperature, the polymer decomposes and one can conclude that the polymer is (almost entirely) removed in the gas stream as a by-product. This is scenario is also supported by the almost complete removal of
the polymer wall as shown in Figure S2. The large band in the range of 1000-1500 cm\(^{-1}\) can be assigned to vibration of Si-containing bonds. The peak around 2400 cm\(^{-1}\) visible in all spectra is attributed to CO\(_2\) from the environment but could also partially due to the presence of some residual carbonized polymer.

**Figure S1-5.** MIR spectra in transmission of HU structure in polymer only (dark gray line), after TiO\(_2\) ALD (light gray line) and Si CVD (black line).