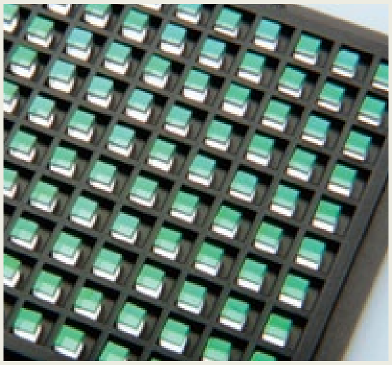
Impossible Optics—Applications & Examples

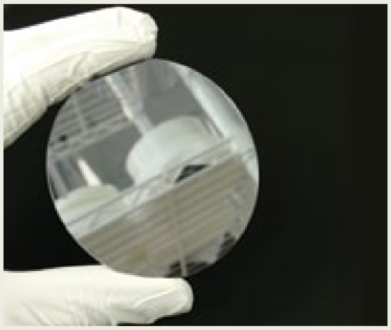
Quick Ramp-up from 1,000 to 30,000 Units per Month



When one of our customers asked us to ramp up from 1,000 to 10,000 delivered parts per month—a seemingly impossible task—we reacted quickly and were able to hit the goal in just eight weeks. Several months later they asked us to ramp up again from 15,000 to 30,000 units per month and we met the requirement in just 4 weeks!

It wasn't easy, but by working closely with our customer and our manufacturing team, we are now delivering thousands of high-tolerance parts per month and can respond quickly to schedule changes. Our background in building state-of-the-art precision measurement instrumentation enables us to push industry limits to the nanometer level—in this case it was a thickness tolerance of ±100 atoms!

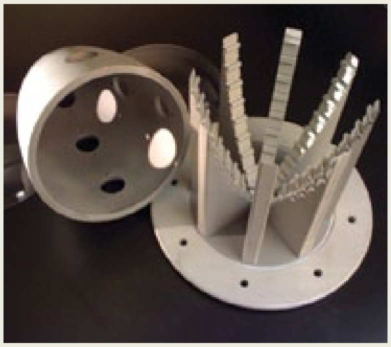
Ultra-flat Wafers & Etalons



By utilizing state-of-the-art metrology, wafer-based optical fabrication and our advanced ion-beam-sputtering (IBS) coatings, we have been able to repeatedly produce ultra-flat, optical grade fused silica, quartz and silicon components. Thickness measurements taken with our laser-based, NIST-traceable SW1500 metrology system confirm total thickness variations (TTV) as low as 11 nm across a 68 mm diameter—a parallelism of less than <0.05 arcseconds!

Custom etalons, filters, retardation plates and wafers are available, coated or uncoated with 20/10 surface quality in sizes from 1.5 × 1.5 mm² to 100 mm diameter, and with local slope errors of < 0.1 µm/inch.

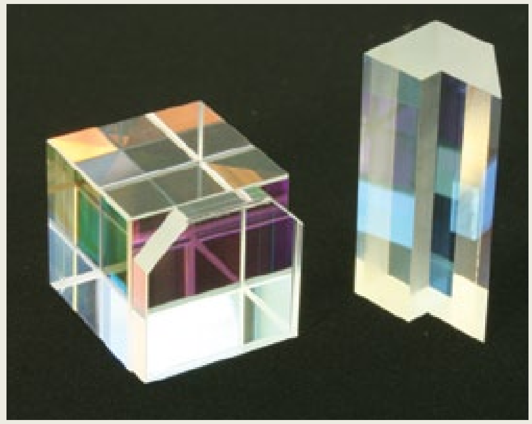
Coatings that Survive up to 1000º C



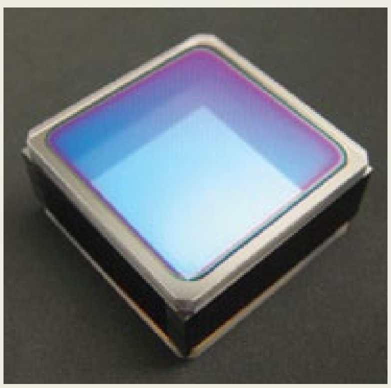
R&D efforts for a Phase 2 SBIR addressed coating requirements for the inside of a missile dome. This included robust, broadband anti-reflection (BBAR) coatings for the 3-5 µm spectral range along with extremely high temperature operation and survivability. PPC's IBS technique solved the challenging variable-thickness requirement by utilizing shadow masking to control coating uniformity. Using our in-house developed VirtualChamber™ 3-D coating simulation tool, we were able to predict the proper mask shape, allowing us to to simulate and coat a variety of non-uniform, spatially-varying coatings. Results demonstrated proper spectral transmission (coating thickness profile) for the dome, and operational survivability to 1000º C!

Monolithic Assemblies with λ/20 TWD

We routinely produce optically bonded assemblies with less than 0.05 waves of transmitted wavefront distortion (TWD) peak-to-valley. λ/10 wavefronts are fairly common on single optical components, but when you build multi-element optic assemblies, these distortions can compound, resulting in much higher levels of distortion. With our nanometer-level tolerances, IBS coatings, and unique zero-bond-length adhesive-free CADB® bonding process, our monolithic optical assemblies consistently exceed even the most stringent specifications including λ/20 peak-to-valley TWD, beam deviation < 30 arcseconds and optical path lengths matched to better than 10 microns.



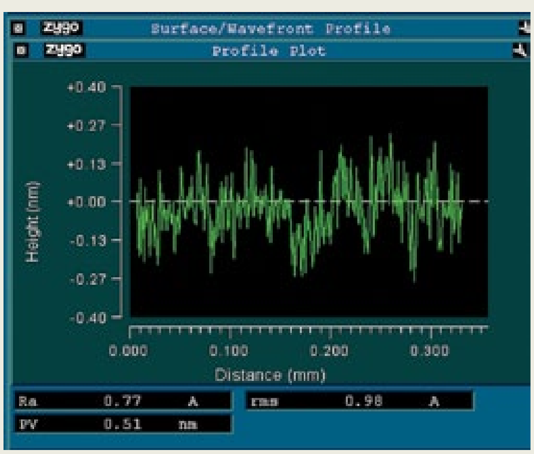
YAG chip laser with cladding on all sides



Built in collaboration with the Engineering Research Center for Extreme Ultraviolet (EUV) Science and Technology and Colorado State University.

This high-power yttrium aluminum garnet (YAG or $Y_3Al_5O_{12}$) chip laser is a completely epoxy-free assembly comprised of several doped YAG and sapphire components. Manufactured using our patent-pending CADB® bonding process and advanced polishing techniques, this part required several iterative processing steps, thus highlighting the importance of robust, durable bonds and meticulous cleaning and handling techniques. From the raw material specifications through the final metrology, we worked together with the customer to meet their budgetary requirements and performance expectations for the final, coated assembly.

Superpolished Sapphire to < 1Å RMS



Once our customers found out that we can polish and measure fused silica surfaces to < 1 angstrom in RMS surface roughness, they immediately asked us if we could do the same thing on sapphire. Within just a few weeks we were able to refine our polishing and cleaning processes to achieve similar surface quality on not just sapphire (shown here), but Ti:sapphire and TGG crystal as well.

Super-polished or laser quality polished substrates and assemblies are ideal for use as low-loss laser mirrors, high energy waveguides and in cavity ring-down spectroscopy (CRDS) where thermal stability, surface scatter and high laser damage thresholds are key requirements.