



Rugged optical mirrors for the operation of Fourier-Transform Spectrometers in rough environments

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The Total Carbon Column Observing Network (TCCON) and the Network for the Detection of Atmospheric Composition Change (NDACC) operate a growing number of Fourier-Transform Spectrometers (FTS) that measure the total column of several atmospheric trace gases. For these measurements, the sun is used as a light source. This is typically achieved by a solar tracker that uses a pair of optical mirrors to guide the sunlight into the instrument.

There is a growing demand to operate these instruments in remote locations that fill the gaps in the global observation network. Besides the logistical challenges of running a remote site, the environment at these locations can be very harsh compared to the sheltered environment of the instruments' home institutions. While the FTS itself is usually well protected inside a building or container, the solar tracker and especially its mirrors are exposed to the environment. There they may suffer from

- temperature fluctuations
- high humidity
- sea salt corrosion at coastal sites
- dirt and dust
- air pollution from anthropogenic sources
- deposition from plants or animals

The Max Planck Institute for Biogeochemistry (MPI-BGC) operates a TCCON station on Ascension Island, about 200 m from the sea. Under the rough conditions at this site, typical optical mirrors that are made for laboratory conditions are destroyed by sea salt spray within a few weeks. Besides, typical gold-coated mirrors cannot be cleaned as their soft surface is easily scratched or damaged.

To overcome these problems, the MPI-BGC has developed optical mirrors that

- offer good reflectivity in the near and mid infrared
- are highly resistant to salt and chlorine
- have a hard surface so that they can be cleaned often and easily
- are not affected by organic solvents
- last for months in very harsh environments
- can be reused after polishing

These mirrors could be applied to most TCCON and NDACC sites. This way, the network could be expanded to regions where operation would have been too challenging so far.