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Atmospheric Measurement Techniques Discussions

Interactive comment on "Rugged optical mirrors for Fourier-Transform Spectrometers operated in harsh environments" *by* D. G. Feist et al.

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Dear referee,

thank you for your helpful comments. In the following, your comments are in bold face and my replies are in standard type face:

With the requirement to better quantify greenhouse gases, establishing TCCON stations in remote environments will be necessary. This paper discusses the problems encountered while operating a TCCON station on Ascension Island, probably the most remote and rough environments in the world for a TCCON instrument at the moment. One of the main components of a TCCON instrument is the solar tracker, which precisely tracks the center of the sun and focuses the

beam onto the interferometer. Its gold coated mirrors are exposed to ambient conditions during the measurements, making them one of the first components to degrade.

The authors presented the problems they encountered using the standard gold coated mirrors. On the search for the best solution, the authors showed different rugged mirror configurations and discussed their limitations. Finally, the authors propose using polished stainless steel mirrors and showed their resilience against the environment of Ascension Island.

I would like to stress that the optical properties of the rugged mirrors were only of secondary concern to us. On Ascension Island, the difference between using rugged mirrors or regular mirrors is having measurements or not having measurements.

I think this work is very important for the future operations of TCCON and NDACC stations in remote and harsh environments. This paper has the potential to be referenced numerous times by both TCCON and NDACC networks.

Thank you for this statement about the importance of our work.

However, as reviewer #1 already stated, the authors need to deepen the paper a bit more, specifically on the characterization of the results using the new mirrors. I recommend this paper for publication in AMT after all the comments of reviewer 1 and a few comments below have been addressed.

The points raised by referee #1 have been addressed in a separate reply.

Additional Comments: Figure 9 shows the measurements of the steel mirrors' reflectivity, normalized for a single reflection. I think the authors should show the same plot for a standard gold mirror, for comparison. What is the difference between the gold and stainless steel mirrors in terms of reflectivity as a function of wavelength?

Thank you for this suggestion. It was actually very interesting to learn more about the

science behind coated optical mirrors which was a very active field about 30–50 years ago. I learned a lot and also found several nice articles that enhance our manuscript's rather short reference list.

The updated version of Fig. 9 for the final manuscript (Fig. 1 in this reply) now also contains reflectance curves for the common mirror materials Au and Al as well as for the main components of stainless steel Fe and Cr.

Also, in this figure, there is a "kink" at around 5100-5200 wavenumbers. Perhaps the authors should comment on this as well as its effect on the retrievals.

The kink is probably just an effect of a number of strong water vapour lines in the spectral range 5100–5600 cm^{-1}. After carefully checking the reflectance measurements that were made in the lab at KIT, it looks like the humidity in the lab was not constant during the measurements. It took several minutes to set up and run the measurements with and without mirrors. There were three people in a rather small room, so the water vapour content of the laboratory air likely increased during this time. As a result, there were amplitude offsets in the measured spectra near water vapour lines. These produced artifacts in the measured reflectance curve that were not caused by the mirror itself. Because the spectral filters used in these measurements were designed for transmission windows between major water vapour lines, most of these artifacts appear near the filter edges.

Since all TCCON retrieval windows are at least 500 cm^{-1} away from the "kink", it should not affect the retrieval in any way.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 10711, 2015.

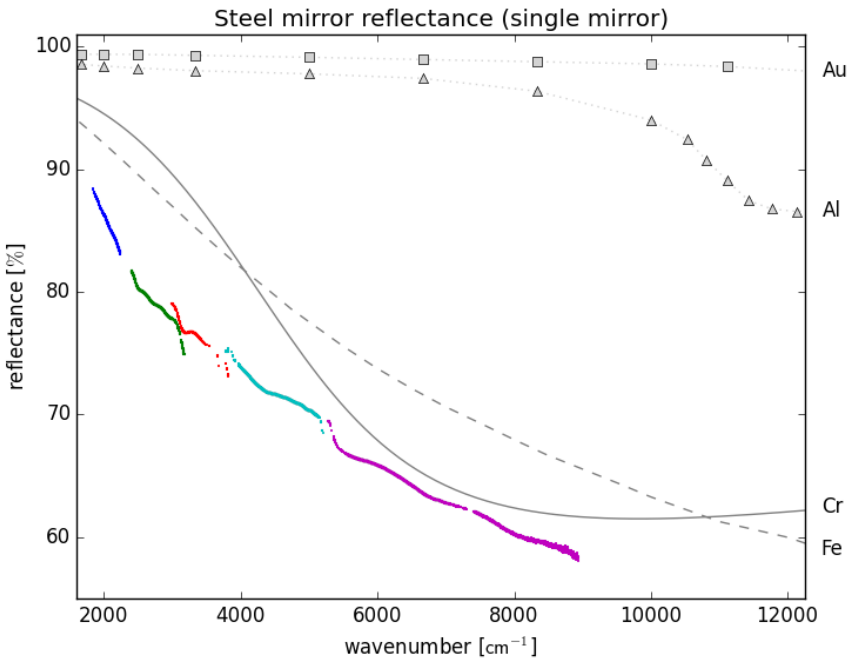

Fig. 1. Updated version of the steel mirror reflectance plot (Fig. 9 in the manuscipt).