

A new AWARD for the Custom Gratings Production Team from NASA Jet Propulsion Laboratory

On September 11th 2006, Dr. David Crisp, JPL NASA - OCO Principal Investigator, presented the JPL award to the Custom Gratings Production team managed by Audrey Liard, for the manufacturing of three outstanding space diffraction gratings for the Orbiting Carbon Observatory.

The orbiting carbon observatory

The Orbiting Carbon Observatory (OCO) is a new Earth orbiting mission sponsored by NASA's Earth System Science Pathfinder (ESSP) Program. The ESSP Program funds competitively selected, low to moderate cost Earth Science missions. These highly focused missions acquire exploratory measurements of the atmosphere, the oceans, the land surface and the solid Earth. These missions share a common goal of improving the capability of Earth scientists to predict changes in weather, climate and natural hazards.

After launch in 2008, the OCO mission will collect precise global measurements of carbon dioxide (CO₂) in the Earth's atmosphere. Scientists will analyze OCO data to improve our understanding of the natural processes and human activities that regulate the abundance and distribution of this important greenhouse gas. This improved understanding will enable more reliable forecasts of future changes in the abundance and distribution of CO₂ in the atmosphere and the effect that these changes may have on the Earth's climate.

The Jet Propulsion Laboratory will lead the OCO effort.

Observatory instrument

The Orbiting Carbon Observatory (OCO)



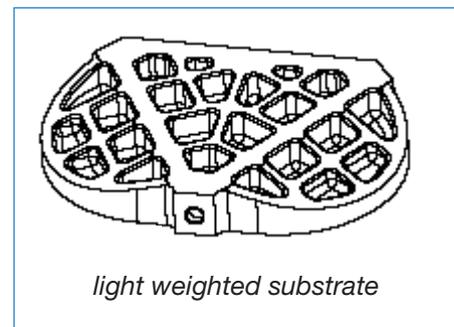
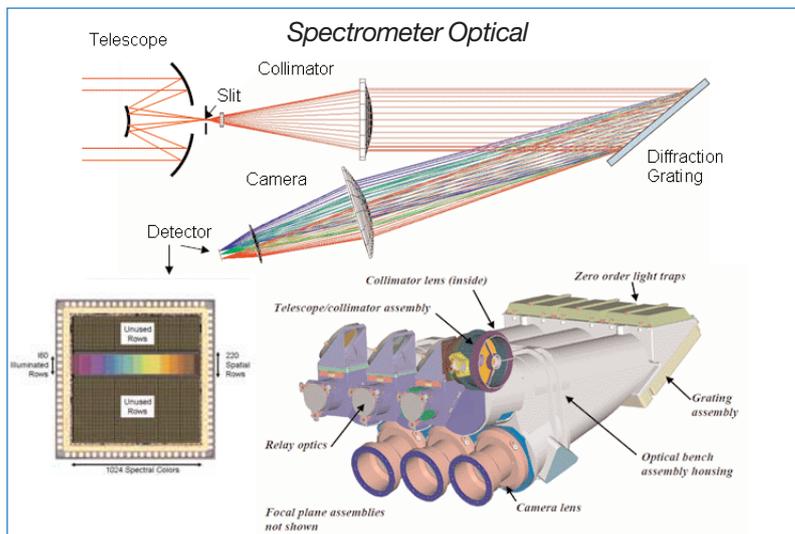
From left to right: Frédéric Desserouer [1], Laurent Marchetti [1], Dr. David Crisp [2], Olivier Nicolle, Director [1], Jean Flamand [1], Gilles Sicsic [1], Audrey Liard [1], Sophie Kaladgew [1]
[1] HORIBA Jobin Yvon - Gratings & OEM Division - [2] Jet Propulsion Laboratory NASA

is a dedicated spacecraft that carries a single instrument comprised of three high resolution grating spectrometers. The instrument, developed by Hamilton Sundstrand Sensor Systems, will acquire the most precise measurements of atmospheric CO₂ ever made from space.

The OCO spectrometers measure sunlight reflected off the Earth's surface. The rays of sunlight that enter the spectrometers pass through the atmosphere twice, once as they travel from the Sun

to the Earth, and then again as they travel from the Earth's surface to the OCO instrument. Carbon dioxide and molecular oxygen molecules in the atmosphere absorb light energy at very specific colors or wavelengths. Thus, the light that reaches the OCO instrument will display diminished amounts of energy at those characteristic wavelengths.

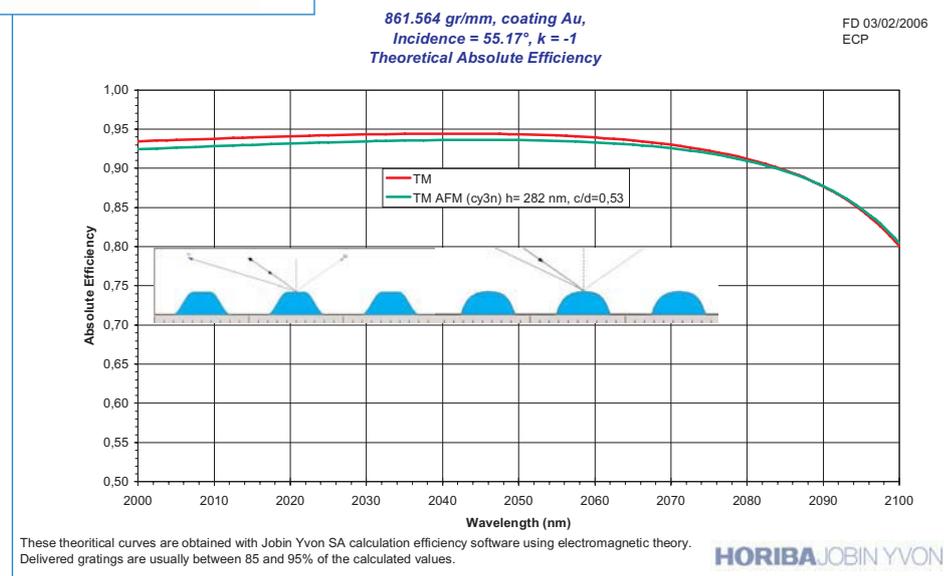
The OCO instrument employs a diffraction grating to separate the inbound light energy into a spectrum of multiple



component colors. The reflection gratings used in the OCO spectrometers consist of a very regularly spaced series of grooves that lie on a very flat surface. The back of a compact disc is an everyday example of a diffraction grating.

The characteristic spectral pattern for CO₂ can alternate from transparent to opaque over very small variations in wavelength. The OCO instrument must be able to detect these dramatic changes, and specify the wavelengths where these variations take place. Thus, the grooves in the instrument diffraction grating are very finely tuned to spread the light spectrum into a large number of very narrow wavelength bands or colors. Indeed, the OCO instrument design incorporates 17,500 different colors to cover the entire wavelength range that can be seen by the human eye. A digital camera covers the same wavelength range using just three colors.

The OCO experiment requires the measurement of three relatively small bands of electromagnetic radiation. The spectral wavelength ranges of these three critical bands are widely separated. To accomplish this task economically, OCO uses three spectrometers instead of one. Each spectrometer measures light in one specific region of the



spectrum. The focal plane associated with each spectrometer is designed to detect very fine differences in wavelength within each of these spectral ranges.

OCO measurements must be very accurate. To eliminate energy from other sources that would generate measurement errors, the light detectors for each camera must remain very cold. To ensure that the detectors remain sufficiently cold, the OCO instrument design includes a cryocooler, which is a refrigeration device. The cryocooler keeps the detector temperature at or near -150° C (-240° F).

So HORIBA Jobin Yvon team was

contacted to produce three different space gratings with high specifications in term of efficiency, spectral resolutions and stray light rejection.

In particular stray light rejection was a real challenge, especially on honeycomb light weighted blanks specifically designed for this space mission. The manufacturing team, succeeded to overcome these difficulties within a limited amount of time. The delivered gratings comply or exceed all the requested specifications.

Source:
<http://oco.jpl.nasa.gov/mission.html>