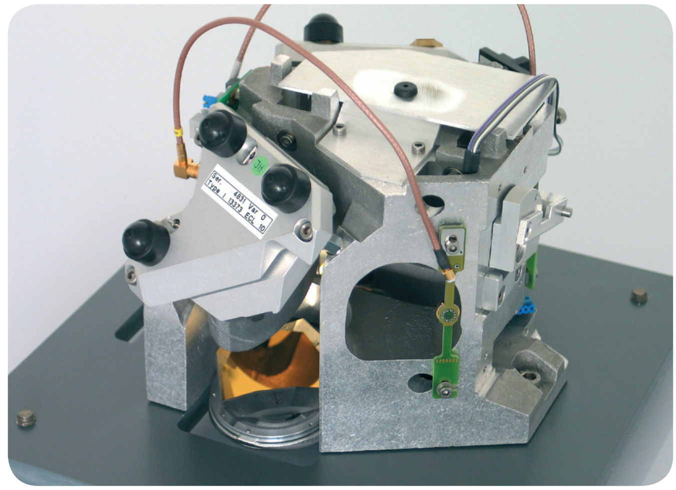
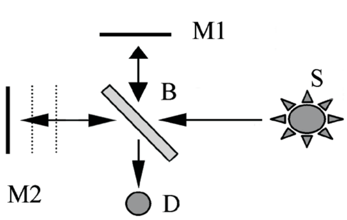
Product Note T14-07/08

Rocksolid Interferometer



Bruker entered the field of FT-IR Spectroscopy in 1974, setting the standards in research FT-IR with evacuable optics, high spectral resolution, and automatic spectral range change. Today Bruker manufactures the widest range of FT-IR spectrometers, offering instruments from routine use represented by the world's smallest FT-IR to advanced high resolution spectrometers with 0.001cm^{-1} spectral resolution. Bruker has led the development of many of today's most important FT-IR innovations and prides itself not only on a high level of customer support but also on technical innovation. Perhaps nowhere is this innovative spirit more apparent than in the design of the Bruker Optics Rocksolid interferometer.

The interferometer is the heart of an FT-IR and is one of the main reasons for the superior performance of Bruker spectrometers. The simplest form of an interferometer is the Michelson type, with flat mirrors, as shown in figure 1. With the exception of refractively scanned interferometers, all interferometers operate on these principles, although variations are found in various FT-IR models. The light from the infrared source impinges on a beamsplitter that is ideally 50% reflective. Therefore 50% of the light is directed to a stationary mirror and 50% to the moving one. The light returning from both mirrors is recombined at the beam splitter. As the moving mirror travels back and forth, various wavelengths of light go in and out of phase. By recording the signal observed by the detector at precise intervals, the raw data for the interferogram is generated. This is then Fourier transformed into the desired spectrum.



S: Source
B: Beamsplitter
M1: Fixed Mirror
M2: Moving Mirror
D: Detector

Fig. 1 Michelson Interferometer

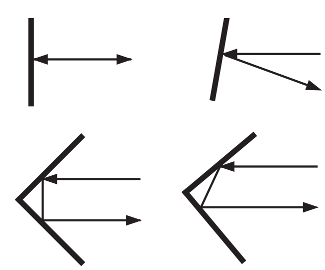


Fig. 2 Comparison of the effect of mirror tilt on a flat mirror (top) vs retroreflecting cube corners (bottom)

Cube corner interferometers are in wide use for laboratory and process applications and have some unique characteristics. Unlike flat mirrors, cube corners are practically immune to mirror tilt (i.e. angular movement of the mirror). This is an important consideration since the light returning to the beamsplitter must be precisely recombined or a reduction in the stability, resolution, and spectral quality will occur.
One approach to address this problem in interferometers with flat mirrors is to use a technique called "dynamic alignment". In the dynamically aligned interferometer of competitive systems, the fixed mirror is equipped with piezo transducers which tilt the mirror after a positional error is detected on the moveable one. That means that the interferogram jitters across the detector element and leads to measurement artifacts. Another disadvantage of a dynamically aligned interferometer is the use of a mechanical bearing which is prone to wearing out. Note that even if a design specifies a drive system that is referred to as a frictionless electromagnetic drive (i.e. voice coil), the bearing itself may in fact be a contact mechanical type prone to wear-out.

At this point we have to mention that the actively true aligned UltraScan interferometer used in the new Bruker Optics VERTEX 80-80v series overcomes the mentioned problems of the competitors' "dynamic alignment" systems.

The Rocksolid interferometer incorporates dual retro reflecting cube corner mirrors in an inverted double pendulum arrangement. A wear-free pivot mechanism is located at the center of mass. This patented design optically eliminates mirror tilt and mechanically prevents mirror shear. It is also resistant to vibration and thermal effects. The wear-free nature of the bearing in the Rocksolid interferometer ensures exceptional stability and reliability even in harsh environments. The high throughput design delivers the highest possible signal-to-noise ratio, resulting in the fastest and most accurate results possible.

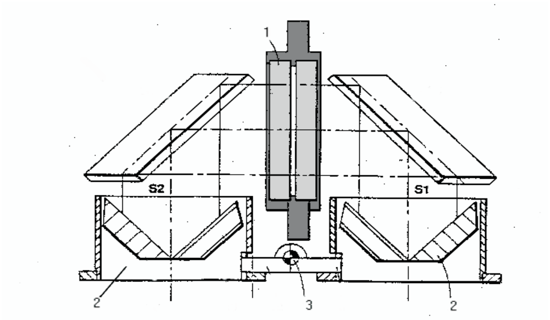


Fig. 3: United States Patent Number 5,309,217 ROCKSOLID layout: 1. Beam Splitter, 2. Cube Corner Retroreflectors, 3. Wear-free pivot mechanism