



VCD PART 3: ALTERNATIVE VCD APPROACHES

Are there alternatives to commercial dedicated VCD units (so far only Chiralir by Bomem-BioTools) or standard FT/IR with CD accessories as from other suppliers?

Answer is yes (probably), let's see a few examples:

At University of Alabama in Huntsville (UAH) they built up an FT/IR spectropolarimeter (FTIRSP), the unit is assembled "inside" the sample compartment of a Nicolet SB6000 FT/IR using the design of Azzam¹ with two wire-grid polarizers and special achromatic retarders² (so no piezoelectric modulator).

Muller matrix of the sample is measured, so even CD data can be extracted.

The approach is very interesting, but probably far from routine analytical use.

A more practical tool may be the Synchronous Sampling Demodulator by GWC Instruments, which was originally designed for PM-FTIRAS³ (polarization-modulation Fourier transform infrared reflection-absorption), so for measurement of linear polarization on thin films at grazing incidence using a suitable PEM modulator and detecting the signal at twice its operating frequency.

GWC is now offering also versions (GWC-SSD-37 & 50) operating at half the normal frequency, so suitable for VCD.

What you need is basically an FT/IR with external beam optics, proper linear polarizer, a couple of CaF₂ lenses, N₂ cooled MCT detector (for speed) with built in preamplifier and a suitable ZnSe PEM (typically from Hinds).

The GWC-SSD box accepts reference signal from the PEM driver and signal from the MCT detector preamplifier.

Fine-tuning of phase must be performed with an oscilloscope. Two signal outputs are provided for FT/IR equipments with dual A/D converters, but also simple single channel units can be used: in this case you must alternatively collect "sum" and "difference" interferograms (operation may be automated with Macro programs of the FT/IR).

The GWC box will replace the usual lock-in amplifier typically used in VCD and reported costs are reasonable.

The claimed advantage is the greater bandwidth compared to a lock-in, with possibility to use faster moving mirror speeds in the interferometer.

The second advantage is the versatility of the kit; you can basically use on any FT/IR in your lab, with no real modification.

It seems that a few FT/IR manufacturers are now selling the GWC unit as part of their package.

But what about actual performance?

With no direct experience it's quite hard to judge: unit is well sold for the far more popular IRRAS technique, but VCD is far more challenging, sensitivity wise.

We have however consistent hopes to be able to test one unit shortly.

Other ways?

Yes: to avoid the use of the expensive (and somehow wavenumber range limiting) ZnSe PEM a set-up with rotating quarter-wave plate was proposed and tested with reasonably good results⁴.

In a somehow similar way, even more back to the origin: if you collimate an FT/IR beam and insert a linear polarizer + Fresnel rhomb (ZnSe) you can generate circularly polarized light. Alternating the linear polarization (by sequential rotation of the polarizer) and subtracting the relevant absorbance data you can get a CD spectra. We followed this approach recently for an educational VIS CD, it works, and we will try to expand to IR shortly.

¹ Azzam R..M.A., *Opt.Lett.*, 2, 1978, 148

² Chenault D.B, Chipman R.A., *US Patent 4,961,634*, 1990

³ Green M.J., Barner B.J., Corn R.M., *Rev.Sci.Instrum.*, 62, 1991, 1426

⁴ Malon P., Keiderling T.A., *Appl.Spectrosc.*, 50, 1996, 669