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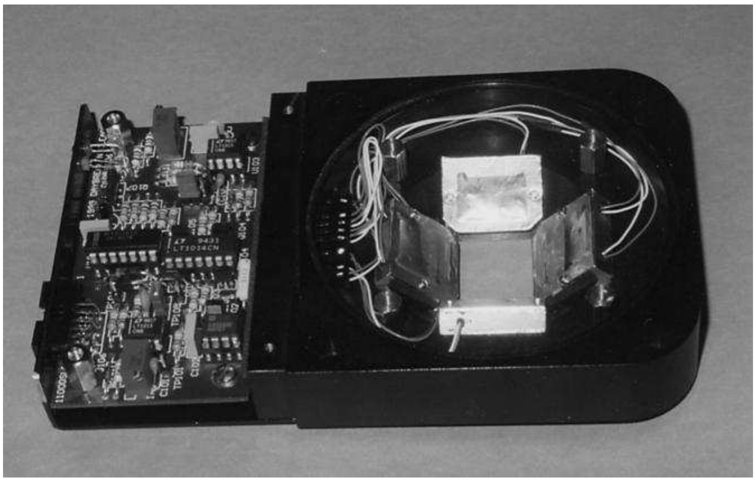
OSL ADAPTERS

1100IR/Vis All SOLID STATE OSL EXCITER (IR and Green or Blue)



We are presently delivering a comprehensive array of OSL illuminators for 1100- and 2200-series systems for visible (blue or green) and IR OSL excitation. We introduced several fiberoptic-based adapters some years ago that combined fiberoptics, for connection to an external light source, with IRLEDs. After years of waiting for sufficiently high power green and blue LEDs, we can finally offer an all solid state solution for zero maintenance. No more lamps to replace! There is also the advantage of linear electrical intensity control from zero to maximum, so that new intensity-ramping techniques can be implemented. The new 1100IR/Vis combines two sets of LED 'light bars' with integrated glass filters to remove out-of-band wavelengths that might increase detector background. The IRLEDs have a RG830 filter to remove the small LED output in the red detectable by a bialkali PMT. This makes the use of BG39 glass in the detector nearly unnecessary, and lowers background when U340 or UG11 filters as used for UV detection. The LEDs we use are part of a family of extremely bright single quantum well devices which includes green and blue emitters. The blue diodes emit at 480 nm with a FHWM of 30 nm, and a very tight center wavelength range of 5 nm total spread and sets are closely matched in output power for improved uniformity of illumination. The green LEDs emit at 515 nm with a FWHM of 40 nm. The green diode sets are carefully matched for intensity AND wavelength (+/- 5 nm: unselected diodes cover a wide 510-545 nm range), since OSL intensity of quartz has a strong dependence on wavelength. Their filtration includes both high side and lowside blocking. With blocking filters, the excitation power delivered to the sample is 30 mW/cm^2 maximum for green, 60 mW/cm^2

for blue. The IR (880nm) LED arrays have recently been doubled, for a total of twenty diodes, and the output now is about 100 mW/cm^2 maximum. The LED light bars with their emission filters are mounted in copper heatsinks within the housing, and the control electronics is mounted there as well. The dimensions of the unit are 96 x 155 x 22 mm. It stacks under the detector with four thumbscrews. See the paper on the 2200 high capacity OSL reader system for further information.

In the 1100 and 1150, a light baffle is installed around the sample carrier platter to minimize scattered IR or visible light hitting samples other than the one being measured on the heating plate. A new (2005) design of the light baffle for the 1100 reader is based on our experience with the 2200 OSL reader. A cover that hugs the sample platter very closely, with only a narrow slit for sweep arm motion, makes a minimum of two reflections and gaps less than 0.25mm to be traversed by scattered light to reach adjacent sample disks. This results in a diminution of OSL signal in the immediately adjacent sample disks by less than 4 per cent for a 1000 second blue light exposure at maximum output. *Historical note: In the case of the 1150, an entirely new lid is provided with an illuminator (fiber optic, IRLED, or both together) built in. This approach is necessary because of geometric constraints due to the projection of the platter stack above the level of the heating plate. Here the light baffle is a cylinder in form covering the entire platter stack, with only a narrow slit to permit the sweep arm to move samples on and off the heating plate.* There have been several enhancements made to the 1000-series hardware and firmware to accommodate OSL. An additional 12-bit digital to analog converter has been added to control the LED array current (0-50 mA), and the interrupt clock is now a separate crystal- controlled signal rather than a divided system clock (which would have introduced small timebase errors at certain divide ratios). There are four timebase choices (10 msec, 100 msec, 1 sec, and 10 sec/channel), and these may be mixed (and also settable to values other than the defaults for extra flexibility). That is, you may select 10 points at 10 msec, 9 points at 100 msec, 9 at 1 sec, and some at 10 sec (or 100 at 1 sec, or whatever). This was done to allow great flexibility, yet keep the amount of data storage to a minimum. Also, this makes it possible to do a long term shinedown with good resolution at the beginning, all within the 100 point format of the TL glow curve records. With this compatibility, it has become possible to treat TL and OSL data reduction in the same way, hopefully making it easier, and making the use of TL and OSL together practical. *The limitation to 100 points was in the TLAPPLIC DOS software, not in the 1000-series, as there is considerable data memory available. There is no practical limit now with the FirstLight software suite.* The shinedown data is buffered so that no short timebase period data is lost because of a serial communications bottleneck. There is software selection of servo intensity control or constant current, and of sample temperature. The TLAPPLIC OSL software also has a background measurement procedure where the total IR bleedthrough and dark control is counted for a period of time. This background is subtracted from the shinedown data (adjusted for timebase period), which then is written to the .SUB data file in a way exactly analogous to TL data. The FirstLight software has additional modes of background removal.

HISTORICAL INFORMATION ON EARLIER OSL LIGHT SOURCES

IMPORTANT NOTE: The new all solid state OSL excitation model 1100OSL-IR/Vis has rendered the incandescent and arc lamp models virtually obsolete. They still have use when a broad range of excitation wavelengths is required, and they remain in our product list, as described below. However, we do not recommend them.

FIBER OPTIC ILLUMINATOR models 1100FOI and 1100FO/L

The other OSL adapters incorporate custom fiberoptic assemblies in a new opposing 'light bar' geometry that results in improved uniformity of excitation and higher efficiency, and are described later in detail. The new version couples 25 per cent more power to the sample, and all points on the sample fall within 10 per cent of the average intensity. The fiber assembly has a 0.9 m free length and plugs into the new 860 Xe arc lamp and 870 halogen lamp OSL sources, as well as into your own light source. For the 1100, the adapter is only 16 mm thick and mounts between the PMT housing and the top lid. For the 1150, the adapter is incorporated into a replacement lid.

New IRLED light bar arrays are incorporated into the same housings for greater flexibility and convenience. The control electronics is mounted with the 1100 or 1150 case, and all instruments come pre-wired for easy installation. Careful attention has been paid to the thermal design of these units, to minimize the change of intensity with LED junction temperature. At full power (about 50 mW/cm2), the intensity change without servo feedback control is only about 3 per cent between cold and warmed-up states. With intensity feedback control using a thermally isolated, temperature compensated detector matched to the LEDs, there is no detectable change. These adapters have a fused silica vacuum window so that they may be left in place during TL measurements. There is adequate room for a variety of optical glass filters for suppression of the exciting radiation. For IROSL, the 2 mm Schott BG-39 filter normally supplied as part of the red-reduction filter for TL is usually sufficient to suppress the short wavelength emission of the LEDs (there is a small emission down to about 700 nm) to an acceptable level. Because of the variation of long wavelength response among 9235QA PMTs, a second BG-39 may be desirable. For 'green' OSL, two U-340 filters are provided (2.5 and 4 mm thickness).

This glass fiber device mounts between the 1100 top lid and the PMT housing. It has two 12 mm wide bar ends mounted in opposition 3 cm apart illuminating the sample at a 45 degree angle. This configuration results in a very compact unit (9.6 cm square, 1.6 cm thick) with minimum sample-detector distance and very good uniformity of illumination. The main bundle is 90 cm long with a highly flexible stainless steel outer protective sheath. This design permits installation of IRLEDs in combination with the fiber optic assembly for added flexibility. The standard detector filter is 5 mm of Hoya U-340. A variant of this filter with a dielectric bandstop for the small red transmission of the U- 340 is available also.

860-SERIES XENON ARC LIGHT SOURCES

It has become increasing apparent that both infrared and visible (green) OSL illumination are desirable so that the data from both feldspars and quartz is obtained. We considered a number of approaches, balancing cost and performance, and finally decided that, with the availability of a new family of compact Xe lamps, that compromise is not necessary. Our new system includes a fiber optic illuminator (model 1100FOI or 1100FO/L) with a high power xenon arc, rather than a low power quartz halogen lamp with very wide passband (orange through blue) that could mount directly on the PMT housing together with an IR LED illuminator (such as described by Botter-Jensen and Duller 1992). We could provide such an attachment, but decided that the Xe arc source is better for a number of reasons. First is flexibility: the source is designed in a modular fashion such that the simple single filter holder we offer in the model 861 could be replaced later with a computer-controlled 8-position filter wheel (as in the model 862); the fiber optic illuminator could also be coupled to a laser or any other light source available. The light output from this lamp is sufficient to provide adequate power to the sample with any of these possible attachments (>20 mW cm-2 at the sample with the interference filter wavelength selector at 10 nm bandwidth). Secondly, the use of a fiber optic illuminator provides excellent uniformity of illumination, as opposed to a single oblique beam. Thirdly, because of the compact detection geometry possible with the fiber illuminator, the light delivered to the PMT is 2-3 times greater than with the oblique beam (where the PMT must be further from the sample). (This also has the benefit of reducing the excitation power required for a decent signal, thus reducing the incremental

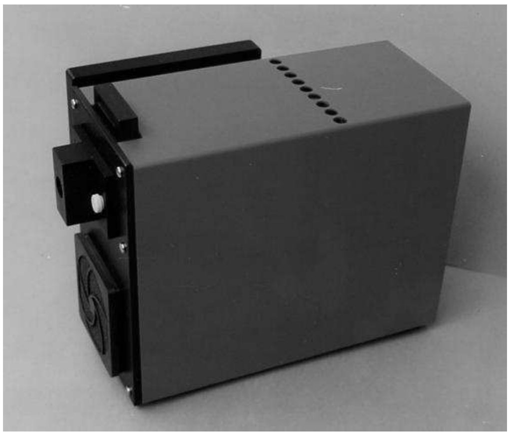
shinedown for short shines, or lengthening the total shinedown if desired.) Fourthly, we have reservations about the use of a wide passband, such as reported by Bøtter-Jensen and Duller (1992). The response curve of OSL emission is a strong function of stimulating wavelength, and possibly important data is lost by using a wide passband. We also suspect that there may be inadequate separation of quartz and feldspar, vitiating the utility of separate green and IR illumination. The much narrower passbands possible with our configuration greatly reduce such ambiguous mixed reponses. We believe that the wide passband approach will prove undesirable in the end, and that the best choice would be to offer the more flexible light source to start with. Fifthly, the Xe lamp life is about 20 times that of the small QTH lamps that would be used in the wide passband type of illuminator. Lastly, while it would be possible to mount a QTH lamp/IRLED illuminator on the 1100 TL reader, it would be somewhat awkward; our fiber illuminator is very compact (9.6 cm square, 1.6 cm high with a 90 cm bundle length) and light in weight. This year we have redesigned the fiber optic assembly, utilizing a dual opposing light bar rather than eight small ends in a ring. This new design yields improved uniformity of illumination, higher efficiency of light transfer to the sample, and coincidentally is more compact, allowing IRLEDs to fit in the adapter as well.

The 300W Xe arc lamp selected for this instrument has a unique design resulting in very high available power deliverable to the sample (the lamp has a high efficiency parabolic collimating reflector integral with the arc for very high geometry of light capture). A tilted custom hot mirror with a Hoya Y-44 glass filter passes the 440-900 nm band and reflects the 900-1250 nm band up to a heatsink. At this point, the power in the collimated beam is approximately 45 mW nm^{-1}. Beyond these filters is an intensity monitor for servoed control and a high-speed (6 msec total actuation time) electronically actuated shutter with high reflectivity blades to prevent thermal damage. One cooling fan is built into the lampholder, and another cools the filters and shutter. Cooling air is ducted to the fans to minimize stray light escaping the instrument. This configuration, plus the power supplies, comprises the base unit (model 860). Added to this is the wavelength selector and output optics and coupling to the fiber optic bundle. An additional Y-44 filter is incorporated into the coupler to further reduce detector background. The standard now is an alternative hot mirror/glass filter combination that blocks 750-1650 nm at reduced cost for those not needing the near IR capabilities (750-900 nm range). In fact, now that the combination FO/IRLED illuminator is available, you probably will not need the added range at all.

Specially manufactured metal-blocked (for 99.99% reflectivity UV to 1200nm) 10 or 20 nm FWHM filters in the range 460 to 850 nm select the passband. The construction of these interference filters makes them inherently safe from thermal effects, and they are kept out of the beam except when needed. The model 861 has a single filter stack holder; the model 862 has room for eight passband filters on the wheel plus an additional space for neutral density filters. The 860-series light sources come with a single passband filter of your choice plus four inconel neutral filters (0.1, 0.2, 0.5, and 1.0 O.D.) that may be used in combination to reduce output to the desired level (ND filters are mounted in rings only 2 mm thick). Beyond the filter holder or selector are the optics that match the collimated beam to the fiber bundle (9 mm diameter). The power supply for the lamp is a high efficiency switching type with intensity servo to compensate for lamp ageing and the small fluctuations due to arc wander (the concentric geometry of the lamp guarantees that spatial noise is small, leaving any fluctuations easy to compensate for). Typical lamp life is 1000 hours, with a 500 hour warranty. The size of the 861 light source is 20 cm high by 25 cm wide by 34 cm long, and is air-cooled.

MODEL 870 HALOGEN GREEN OSL LIGHT SOURCE

To meet a demand for a lower cost green OSL light source, we have developed the model 870. This uses a 150 W miniature lamp with integral dichroic focusing reflector (lamp life is typically 200 hours, and replacement cost is very low). This reflector efficiently couples the light into the 9 mm optical fiber bundle of the Daybreak OSL fiber optic illuminators. Being dichroic, little of the light of wavelengths longer than 700 nm is reflected into the bundle. To further narrow the wavelength region, a combination of tilted hot mirror, sharp cut-on interference filter (50 per cent transmission at 575 nm), Hoya LP-15 IR suppression glass filter, and a Hoya Y-44 sharp cut-off glass filter are interposed between lamp and fiber input. There is a slide for holding up to 12 mm of additional filters (additional cut-off/passband filter and/or neutral density filters for intensity control). Rather than using the expensive iris shutter employed in the 860-series, the shutter in the 870, in the interests of economy, has a single blade actuated by a rotary solenoid. Shutter speed is a respectable 6 msec to open or close. The power supply is a switching type with universal AC input. The lamp is intensity servoed for stability. Two fans cool the lamp/filters and the power supply. The air supply and exhaust is ducted so there is no direct lightpath out to the laboratory. The 870 is remarkably compact (20 cm high x 12 cm wide x 26 cm long).



Since the power output to the sample is considerable (about 70 mW/cm^2 at the sample in the 440-575 nm passband), it is feasible to use 10-35 nm wide interference filters to more narrowly define the excitation wavelength. For example, an unblocked 514 nm filter, 34 nm wide (90 per cent transmission), yielded a power output to the sample of 20 mW/cm^2. Since excitation levels of 0.3 to 3 mW/cm^2 are usual for OSL, this leaves plenty of reserve power for low sensitivity samples even with a narrowed passband. A standard 500 nm filter(10nm FWHM, 50 per cent transmission) gave 3 mW/cm^2. The success of the 870 in delivering excitation power to the sample makes us reconsider some of our earlier misgivings about halogen light sources, and we can recommend it even for those who wish to work with fairly narrow bandwidths.