

LabVIEW controlled cathodoluminescence equipment

J. Bok, P. Schauer

Institute of Scientific Instruments of the AS CR, v.v.i., Kralovopolska 147,
CZ-61264 Brno, Czech Republic

bok@isibrno.cz

Keywords: cathodoluminescence, scintillator, electron detector, LabVIEW, GPIB

Cathodoluminescence (CL) is an opto-electronic phenomenon of a large number of solids, when an incident electron beam causes the light emission. This phenomenon is widely utilized in electron beam instruments (for example in the SEM) not only for a scintillation electron detector, but also as a significant imaging and analyzing SEM mode. So, the topic of CL is an important method for understanding of transition effects and of other processes not only in scintillators, but also in many other solids studied.

In our laboratory, CL has been studied using the modular CL equipment [1], where a transparent specimen (including a transparent substrate if necessary) is positioned at the face of the light guide. The CL emission is guided from the substrate side to a photocathode of the photomultiplier tube (PMT). At the CL spectra measurement, the emitted light is guided to the spectrometer where the PMT is positioned at the output slit. If necessary, it is possible to measure in a synchronous mode using the modulated beam and a lock-in nanovoltmeter to eliminate a noise/background. The equipment is controlled by the PC using both the GPIB bus (IEEE-488 standard) and the USB 2.0 bus.

As the spectrometer the model iHR320 from company HORIBA Jobin Yvon has been used. This spectrometer is equipped with three ruled gratings with different light efficiencies over different spectral ranges. The spectrometer is fully controlled via USB 2.0. For data acquisition a voltage-mode has been used, which means that a voltage on a PMT anode resistor has been measured. The noise has been reduced by the suitable time integration constant. The Horiba JY provides his own software called SynerJY to control the spectrometer. This software supported by OriginLab software possesses a few limitations including a poor data acquisition channel calibration and measurement. For the signal measurement from the PMT the data acquisition unit SpectrAcq2 from HORIBA JY has been tried. But using this unit, serious problems with the background voltage level and noise have been remarked due to ground loops through the computer. Therefore, the SpectrAcq2 has been replaced by the HP 34401A multimeter and the SynerJY has been rejected.

In our laboratory, control software has been created using National Instrument LabVIEW development environment and LabVIEW drivers of individual instruments. Among others, the program is able to control the spectrometer iHR320 and get spectral intensity and excitation beam data using the couple of multimeters HP 34401A. In addition, it provides data collection of different channels using Agilent 34970A data acquisition switch unit. The main window of the program is shown in the Figure 1. The window must be as dark as possible to eliminate the background light in a dark laboratory. The software can collect the CL signal in two modes: (1) in the time resolved measurement mode for the investigation of the time evolution of the CL intensity, and (2) in the wavelength resolved measurement mode for the study of CL emission spectra. The upper part of the window provides output information, whereas the lower one is assigned for the parameter settings. The boxes labeled as part **A** are numeric signal indicators. According to the user choice the indicated values can be displayed in the graph (part **B**) alternatively as the time resolved measurement or as the spectrum scan. Experimental parameters, as communication and acquisition channels,

time constants spectrometer gratings, slits, mirrors and others, must be set before the measurement using the boxes of control tab C. In fact, the presented LabVIEW software is able to acquire signals using more different signal channels. Besides CL intensity and excitation beam current, also sample temperature, vacuum pressure and other can be controlled and recorded as parameters. In the box D user can choose the data output file path for further processing. The boxes of the subwindow E are intended for settings of the time resolved measurement. After the measurement is started the data are collected in an exponential time interval to record fast evolved processes at the beginning of the measurement. After the time specified in the text box “Exp time till” the program begins to collect data using a constant time interval according to the constant in the box “Time interval”. The boxes of the subwindow F are used for the spectral scan, where the “Start WL” and “Finish WL” spectral range is set. The scanning wavelength step is adjusted in the “Step” box. Clicking the “WL Jump” button the spectrometer moves to the specified finish position for the time measurement at a desired narrow band of wavelengths. Clicking on the button “WL Scan” the program starts to move the spectrometer grids and to collect the signal data over the required spectral range.

We kindly acknowledge the support of the project [2].

[1] P. Schauer, R. Atrata, *Fine Mech. Opt.* **42** (1997), p.340.

[2] Work was supported by the Grant No. IAA100100622 of the Grant Agency of the Academy of Science of the Czech Republic.

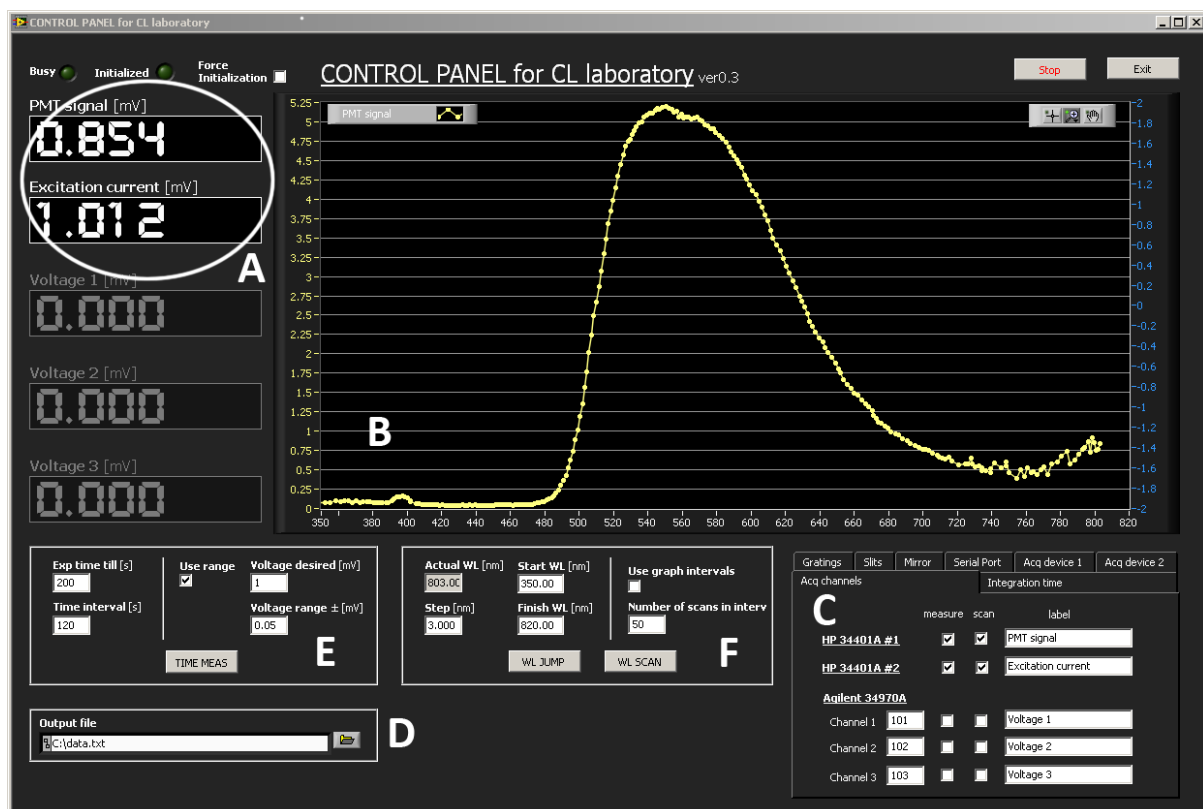


Figure 1. The control window of the CL equipment shows the measurement of the CL emission spectrum of the YAG:Ce single crystal scintillator. For better understanding of the control panel, the individual parts of the screenshot showed are additionally labeled by the white letters “A” to “F”. See the abstract text for details and for the experimental configuration.