# CATHODOLUMINESCENCE SPECTRA MEASUREMENT

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## 1. Introduction
In our laboratory the equipment for the investigation of cathodoluminescent (CL) properties of solid specimens has been built [1]. The equipment is based on the completely rebuilt Tesla BS242 electron microscope, supplied by the light collection UV transmitting system, and by a fast and efficient photomultiplier tube (PMT) as the detection unit. The CL properties of specimens (slim disks) can be measured in continuous or pulse modes. So, in addition to the efficiency and decay times the emission spectra can be measured for 10 keV electron beams.

## 2. Measurement system
The layout of the measurement system is shown in Fig. 1. Contrary to the direct measurement of the efficiency or decay characteristics, at the spectral measurement the CL emission is guided to the entrance slit of the mirror monochromator (Carl Zeiss Jena SPM 2), and the PMT (EMI 9558B) is positioned at the output slit of the monochromator. As the signal to
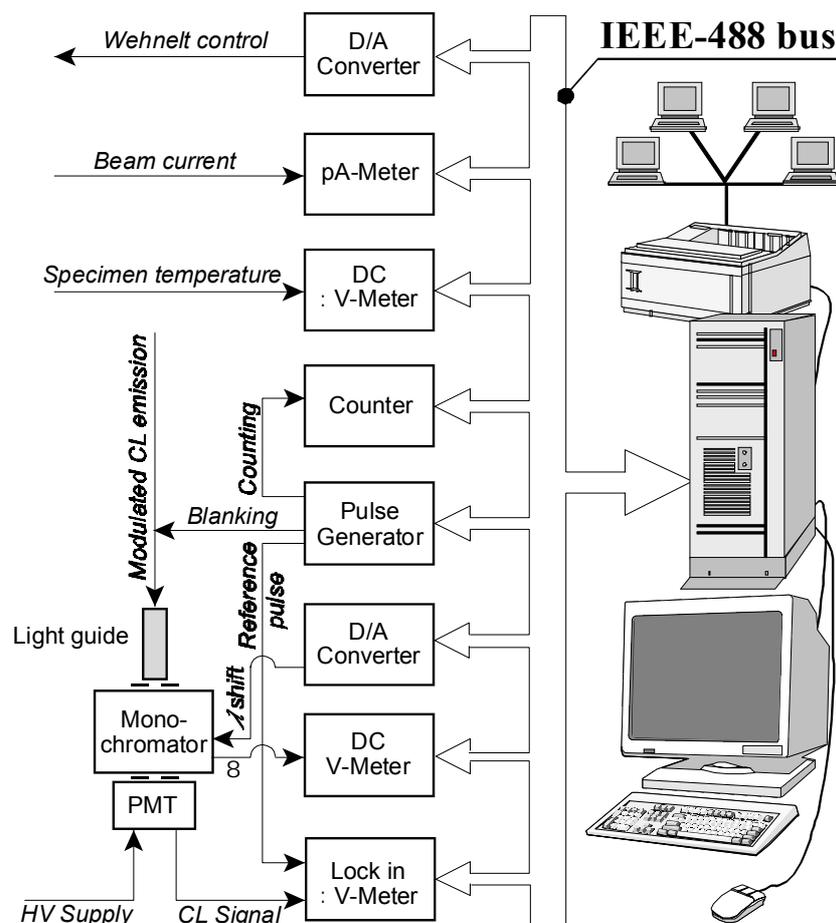


*Figure 1: IEEE-488 bus layout for the control of the CL emission spectra measurement.*

noise/background ratios of most of spectral lines are very small, it is necessary to measure the CL emission in a synchronous mode using the modulated beam and a lock-in nanovoltmeter. The reference pulse is taken from the triggering output of the beam modulating generator. The manual shift of the monochromator wavelength was replaced by a small unit with the electromotor controllable using the D/A converter and PC. The wavelength shift is grabbed using a revolution sensor. An investigated transparent specimen (with a transparent substrate if necessary) is positioned in the specimen chamber [2] facing the light guide. The blanking diaphragm is placed above the specimen. The specimen can be heated, and the temperature can be measured. The Faraday cage was used to the beam current measurement and to the consequential Wehnelt control.

### 3. Control and measurement bus

The individual instruments are connected to the general purpose interface bus (GPIB, known as IEEE-488 standard), and the measuring apparatus is controlled by the PC, that also processes the obtained data. The GPIB bus is driven using the Agilent Technologies 82350A PCI GPIB interface card shown in Fig. 2. This card with built-in buffering de-couples GPIB transfers from the PCI bus transfers. The buffering provides I/O and system performance that is superior to direct memory access (DMA) up to 750 KB/s. The card is software configurable and compatible with the plug-and-play standard. The GPIB bus is formed by this card connected to individual GPIB equipped instruments via GPIB cables. The GPIB card was controlled using Agilent Virtual Instrument Software Architecture (VISA) I/O drivers for Windows 98. The VISA I/O library was preferred for the measurement, because it is designed according to the VXI plug&play (System Alliance) standard that allows different instruments to run on the same system. Contrary to VISA, the alternative Agilent Standard Instrument Control Library (SICL - developed by HP and Agilent) is portable at the source code level from one system to another with little changes.
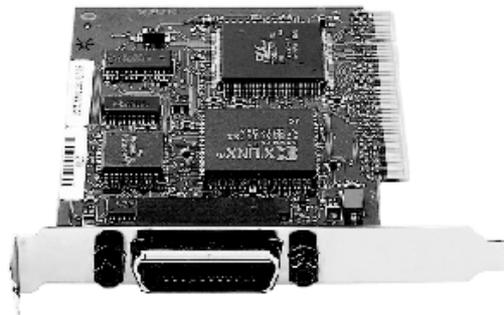


*Figure 2: The Agilent 82350A PCI GPIB card having the IEEE-488 interface for accessing and controlling instruments and for data exchange.*
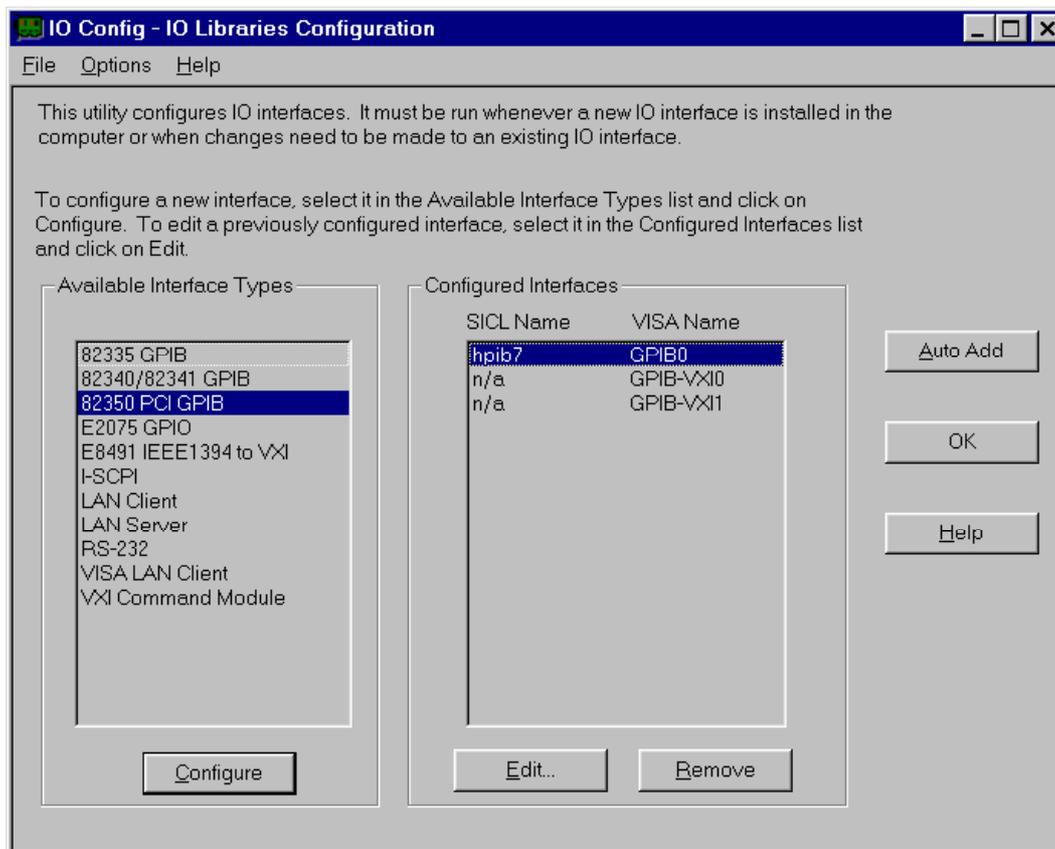
*Figure 3: The main window of the IO Config. This utility assists for the setup of the GPIB interface.*
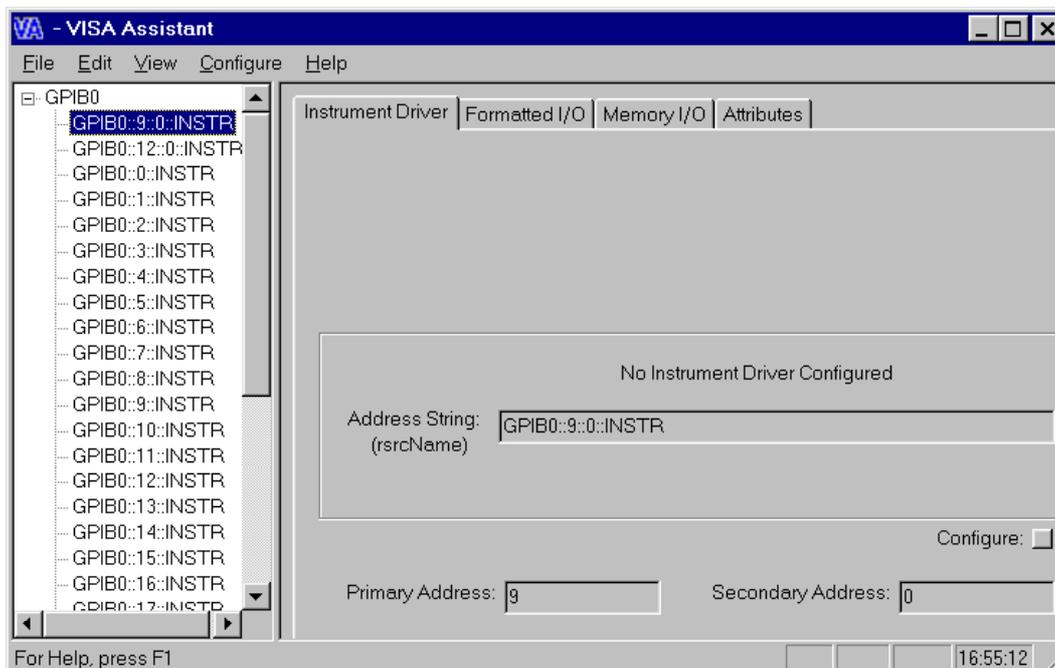


*Figure 4: Typical window of the VISA Assistant utility showing the system instrument view.*

**4. I/O Configuration**

The GPIB card and bus were adjusted and tested for the measurement using Agilent IO Config and VISA Assistant utilities. The interface must be configured before it is used with the I/O libraries. IO Config (Fig. 3) assigned the interface name and logical unit number to the GPIB card, as well as other necessary configuration values for the interface. This information is passed in the parameter string of the function called in the program. The VISA Assistant utility (Fig. 4) was used for the test of the GPIB bus. It was used to send and receive strings to instruments which support formatted I/O. VISA Assistant also allowed us to read and write memory areas, and to describe attributes that are associated with the instruments.

**5. Measurement**

Utilising the MS Windows 98 and the Agilent I/O Libraries, it was possible to control the data flow through the bus to/from the Agilent 34970A data acquisition switch unit, Agilent 34401A multimeters, and other IEEE-488 equipped instruments. The PC was connected to the network, and remote operations were available. After application of the wavelength calibration and signal corrections for the photocathode sensitivity emission spectra were obtained. The data measuring and processing software (including calibration and corrections) was written in the Borland C++ using the Agilent IO Libraries.

**References**
[1] Autrata, R. and Schauer, P.: Scanning Microsc. Suppl. (1996) **9**, 1-12.
[2] Schauer, P. and Autrata, R.: Proc. of ICEM 15, Durban, South Africa, (Sep 2002), in print.