Fluorescence Spectrophotometer

FM-FS-A202

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Index

1. Safety Measures

Important Safety Information
This symbol indicates important safety instructions for operating the instrument. Carefully read and follow all instructions to ensure safe and proper use of the equipment.

Electrical Hazard Warning
This symbol indicates a potential electrical hazard associated with operating the equipment. Only a qualified professional should handle such situations, following the appropriate safety procedures.
Note: This label is affixed to the power switch and trigger of the instrument.

Hot Surface Warning
This symbol indicates that the surface may be hot. Handle with caution and follow the provided instructions carefully to avoid burns or injury.

Points for Attention During Operation

1) **Operating Environment:** The instrument is designed for use in a laboratory setting. If used on-site, the environmental conditions must closely match those of the laboratory.

2) **Transport and Relocation:** If moving the instrument to another location, use the original packing materials to ensure safe transport.

3) **Power-On/Off**
Power On: Turn on the xenon lamp power source first. Once the lamp is lit, turn on the main unit of the spectrophotometer. Allow the xenon lamp to stabilize for at least 30 minutes after lighting.
Power Off: Turn off the spectrophotometer main unit first. Then turn off the xenon lamp power source. Wait 60 seconds before turning the lamp back on if needed.

4) **Xenon Lamp Ignition Failure:** If the lamp fails to ignite and emits squeaking or sparking sounds, immediately turn off the power. Wait a few seconds before attempting to power on again. To extend lamp life, avoid frequent on/off switching under high voltage.

5) **Heat Dissipation Warning:** The heat dissipation outlet (top-left back of the unit) becomes very hot during operation. Do not touch this area. Ensure proper air circulation around the vent.

6) **Fan Operation Check:** After startup, confirm that the cooling fan is running properly. If not, shut down the instrument and have it inspected before further use.

7) **PMT (Photomultiplier Tube) Protection:** When the PMT level is above 6, avoid exposing the sample compartment to high-intensity light. For unknown samples, gradually increase the PMT level from low to high (1–17).

8) **Zero-Point Adjustment:** After changing the PMT level, re-check and adjust the fluorescence zero point if necessary.

9) **Software or System Errors:** If a computer error occurs due to improper operation or interference, immediately turn off the spectrophotometer. If the software is unresponsive, use Task Manager to end the process, then restart the software and instrument.

10) **Monochromator and Optical Components:** Do not loosen any screws inside the monochromator. Keep all optical devices and the working environment clean at all times.

11) **Maintenance and Safety:** Always turn off the power before opening the instrument cover. After removing the top cover, avoid contact with high-voltage components located at the left-rear base of the unit.

2. Introduction

Fluorescence Spectrophotometer FM-FS-A202 offers a versatile wavelength range from 200 to 900 nm, enabling accurate analysis across ultraviolet, visible, and near-infrared spectra. This includes software for fluorescence analysis and data export, ensuring precise results. It features fast scanning speeds, completing full-spectrum analysis reaching up to 30,000 nm/min. Our Spectrophotometer incorporates a replaceable interference filter system for flexible excitation.

3. Features

1. High-intensity light source
2. Multi-sample compatibility
3. Integrated USB connectivity
4. Real-time data analysis
5. Advanced noise reduction

4. Specifications

Model No.	FM-FS-A202
Wavelength Range	200nm to 900nm
Detection Sensitivity	S/N ≥ 150 (P-P)
Excitation Wavelength Bandwidth	10nm
Microprocessor	PID 0 to 199.9
Accuracy	±1.0nm
Repeatability	≤0.5nm
Optional Range	200nm to 900nm
Emission Wavelength Range	200nm to 870nm
Wavelength Scanning Speed	Fast 30000nm/min, fine scan 15nm/min
Measure Linearity	Correlation coefficient ≥ 0.995
Gain Adjustment Range	1 to 17 options available
Integral Response Time	6 options: 0.1s to 4s
Resolution Ratio	Bandwidth of 10nm, transmission range of 0.001μm
Time Scan Settings	Can be set arbitrarily, up to 60000s high
Concentration Range	0 to 199.9%
Data Transmission Mode	USB
Photometric Value Range	0.00 to 600
Unit	-300 to 1999 conc
Peak Intensity Repeatability	≤1.5%
Power Consumption	200W
Power Supply	220V/50Hz, 110V/60Hz
Dimensions (W×D×H)	442 × 392 × 250 mm
Net Weight	10 kg
Gross Weight	14 kg

5. Applications

Fluorescence Spectrophotometer FM-FS-A202 is used for analyzing fluorescence in research, pharmaceuticals, and environmental monitoring. It applies in laboratories and industrial settings for precise sample measurement and analysis.

6. Instrument Introduction

6.1 Instrument Appearance and Performance

Sample Compartment: Contains the cell holder, which is used to securely hold the sample cell during measurement.

Power Switch: Used to turn the instrument's power supply on or off.

Fuse Holder: Designed to house the fuse, providing overcurrent protection for the instrument.

Power Socket: Serves as the connection point for the power cable that supplies electricity to the instrument.

Xenon Lamp Switch: Used to control the Xenon lamp, allowing it to be turned on or off as needed.

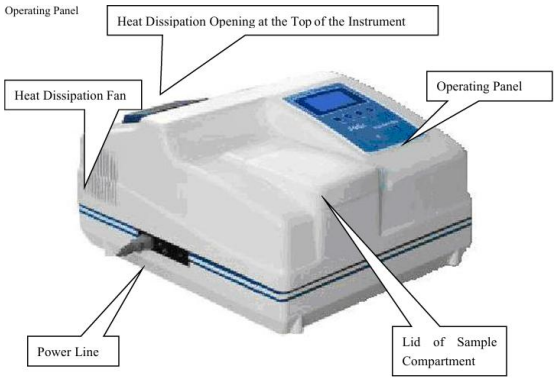

Figure-1

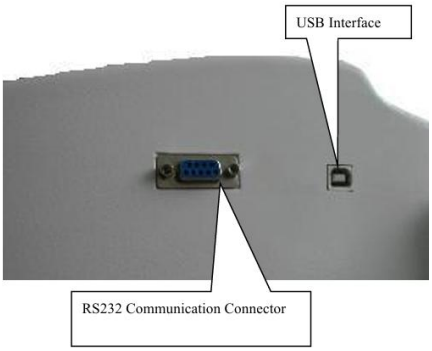

Figure-2

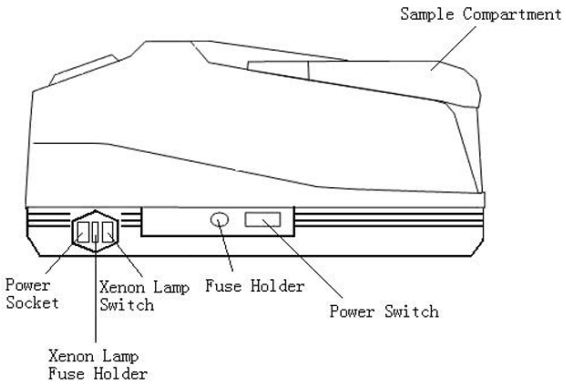

Figure-3 (Left Side View)

Main Components

1. Xenon Lamp

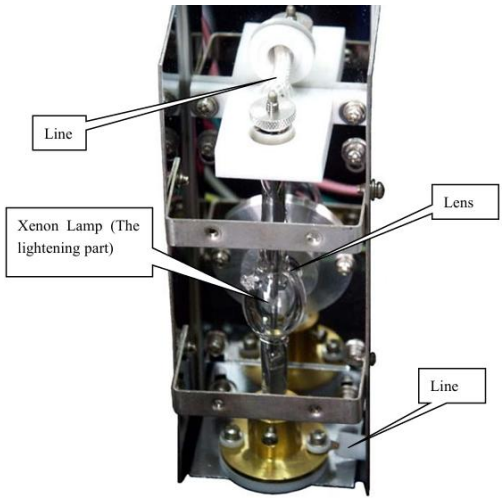

Figure-4 (Xenon Lamp and Lamp Holder)

2. Sample Compartment

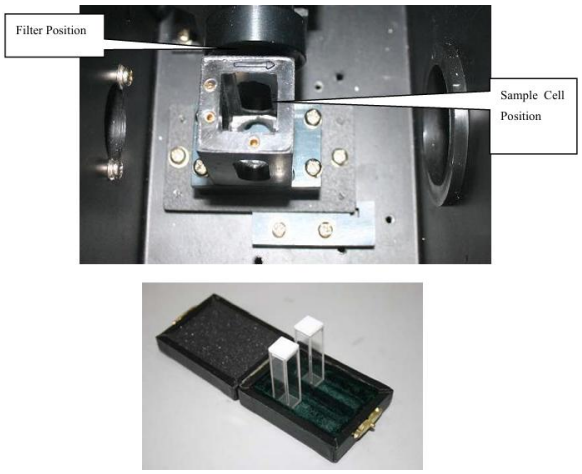

Figure-5 (Sample Compartment and Quartz Sample Cell [10mm])

3. Filter

Figure-6 (Filter [center wavelength 365 nm])

6.2 Operating Panel of the Instrument

Figure-7 (Operating panel)

1. Mode key
2. Print key
3. Adj0% key
4. Normalize key
5. Display Window.

7. Installation

7.1 Installation Environment

The instrument is designed for use in laboratory settings for analytical measurements and must be used in conjunction with a computer. To ensure optimal performance and longevity, the following environmental conditions must be met:

1) **Laboratory Environment**
   - **Temperature Range:** 10°C to 30°C
   - **Humidity:** Less than 85% relative humidity.
   - **Air Quality:** The environment should be free of corrosive gases and organic or inorganic solvent vapors that absorb ultraviolet radiation.

2) **Work Surface:** The instrument must be placed on a stable, level, and vibration-free surface. Avoid exposure to direct sunlight and excessive dust.

3) **Power Supply:** The power source should provide an alternating voltage of:
   - 220V ± 22V or
   - 110V ± 11V, depending on the model and regional settings.

4) **Relocation and On-Site Use:** If the instrument is to be used outside the laboratory or relocated, the new environment must meet the conditions specified above. When transporting the instrument, always use the original packaging materials to prevent damage.

7.2 Unpacking and Inspection

The Fluoro spectrophotometer main unit, along with either the computer or printer (if applicable), is securely packaged in a fiberboard box. For long-distance shipments, a wooden outer box may be provided upon request for additional protection.

1) **Inspecting the Outer Packaging:** Before opening the package, inspect the outer box for any signs of damage.

2) **Unpacking and Inventory Check:** Carefully open the box at the adhesive seal. Gently remove the main unit and all contents. Retain the original packaging for future transport or storage. Perform a thorough check of the contents against the included packing list. Ensure that all of the following are present and undamaged:
   - Fluoro spectrophotometer main unit
   - Standard accessories and fittings
   - Any optional components purchased
   - Spare parts

7.3 Process of Installation

1) **Cleaning:** Before installation, remove all adhesive tapes and protective materials used during shipping. Gently clean the instrument's exterior to remove any dust or residue.

2) **Verifying Power Supply Compatibility:** Ensure that the power supply voltage in your location matches the voltage requirements of the instrument. Using an incompatible voltage can damage the device.

3) **Connecting the Power Cord:** Place the Fluoro spectrophotometer and any connected equipment (e.g., computer or printer) on a stable, flat work surface. Maintain a minimum clearance of 10 cm between the equipment and the wall to allow for proper ventilation. Use the provided power cord to connect the instrument to a properly grounded power outlet in the laboratory.

7.4 Adjustment of the Instrument

7.4.1 Signal-to-Noise Ratio Test (Using Raman Spectral Peak of Water)

1) **Measurement Using the Standalone Instrument:** Ensure the sample cell is empty before beginning. First, switch on the xenon lamp and confirm it is lit. Then, power on the Fluoro spectrophotometer. Upon startup, the instrument will begin an automatic initialization, which includes self-checking (via computer if connected) and wavelength self-correction. This process takes a few minutes.

2) **Preheating:** Allow the instrument to preheat for at least 30 minutes to ensure the xenon lamp and electronic components reach thermal equilibrium. Accurate measurements depend on this stabilization period.

3) **Sample Preparation:** Fill a clean quartz sample cell with redistilled water. Avoid contaminating the optical surfaces; handle the cell diagonally by the edges and gently place it into the sample holder.
Wavelength Adjustment: Set the emission wavelength to 415 nm.
⚠ **Note:** A dirty quartz cell can significantly reduce precision and affect the signal-to-noise ratio (S/N).

4) **PMT Level Adjustment:** Adjust the PMT level so that the fluorescence intensity of the water sample is within 100–200 units. Locate the maximum fluorescence intensity (λ_{max}) near 415 nm.
At λ_{max}, observe the intensity for 2 minutes. Record the maximum and minimum values.
Calculate the average intensity: (Max + Min) ÷ 2 = Average Fluorescence Intensity (Max + Min) ÷ 2 = Average Fluorescence Intensity (Max + Min) ÷ 2 = Average Fluorescence Intensity
Calculate the noise: Max – Min= Noise Value Max - Min = Noise Value Max – Min = Noise Value

Now, adjust the wavelength to 315 nm to measure the background fluorescence of the water sample.

Calculate the Signal-to-Noise Ratio (S/N) using: (Average Intensity at λ max−Background Intensity at 315nm) ÷ Noise (Average Intensity at λ_{max} - Background Intensity at 315 nm) ÷ Noise (Average Intensity at λ max−Background Intensity at 315nm) ÷ Noise

Product specification requires: S/N ≥ 150

Important Notes:

Protect the PMT: When the PMT level is set above 6, avoid exposing the sample compartment to strong light.

Zero-point validation: Adjusting the PMT level may shift the fluorescence zero-point. After setting the PMT, recheck and adjust the zero-point if needed.

5) Shutting Down the Instrument

After testing is complete, turn off the xenon lamp first. Then, power down the Fluoro spectrophotometer main unit. Testing Mode by using the Instrument in Combination with an Online Computer. Finish the measurement for the Raman Spectral Peak of water by using wavelength scan and time scan in the computer software. The use of software please turn to Part Two.

7.4.2 Checking the Wavelength of the Instrument

The instrument can automatically check the accuracy of indicated value of the instrument wavelength. If finding a mistake, a mercury-arc lamp to check (If there is no mercury-arc lamp, a fluorescent lamp can be used instead, but a professional person is needed to do such work. The concrete method and the correcting procedures will be briefed through training.

No.	Wavelength	No.	Wavelength
1.	253.65	7.	404.66
2.	296.73	8.	407.78
3.	302.15	9.	435.84
4.	313.16	10.	546.07
5.	334.15	11.	576.96
6.	365.01	12.	579.07

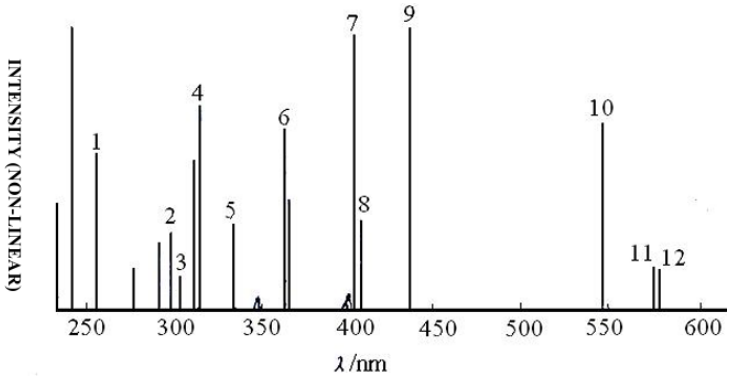

Figure-10

8. Working Principle

8.1 Signal Processing and Control System

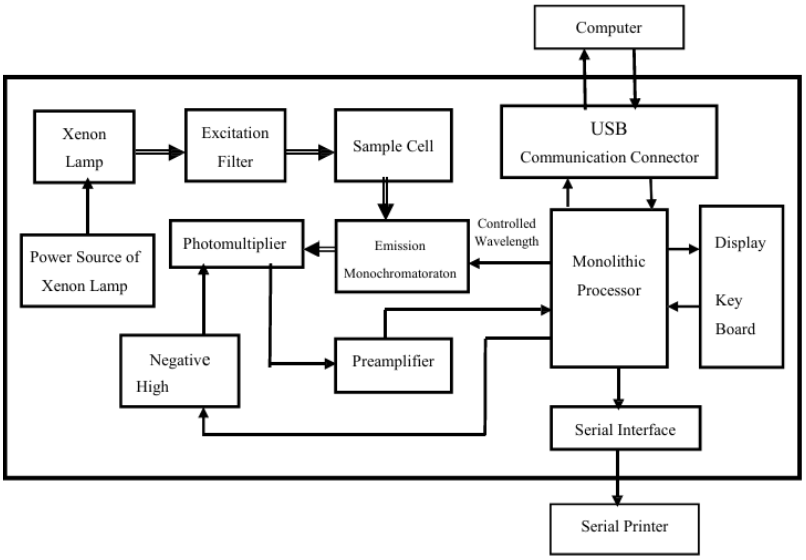

Figure-8

8.2 Optical System

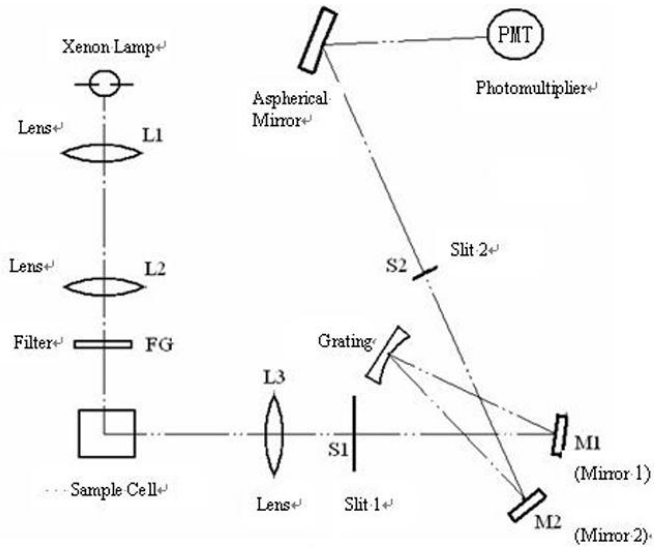

Figure-9

8.3 Measurement Functions of the Instrument

1) **Working Modes of Measurement**
   Wavelength Scan Mode: In this mode, the excitation wavelength is kept constant while the emission spectrum is recorded. The fluorescent intensity of the sample is measured as it varies with the emission wavelength.
   Time Scan Mode: With the excitation wavelength fixed, the fluorescent intensity of the sample is recorded over time, providing a time-dependent fluorescence profile.

Quantitative Analysis Mode: Based on the fluorometric equation F = KC, under consistent experimental conditions, the fluorescence intensity (F) is directly proportional to the concentration (C) of the target analyte. The constant K is determined by measuring the fluorescence intensity of standard solutions and applying curve fitting techniques. Once K is known, the concentration of the analyte in unknown samples can be calculated using the linear relationship. Calibration can also be performed using the standard curve method or the standard addition method.

Concentration Measurement: Concentrations can also be determined directly using the instrument's single-point calibration feature, allowing for quick and straightforward readings.

2) Modes of Data Measurement

Measurement Using the Standalone Instrument: The instrument allows for direct measurement through its built-in control panel. By utilizing the function keys and monitoring the status indicators, users can operate the device and read measurement data directly from the display screen.

Measurement Using an Online Computer: The instrument can be connected to a computer via a communication port. All operations—including instrument control, parameter configuration, and real-time data acquisition—are managed through dedicated software. This software provides robust features for spectral analysis, data processing, and storage.

Note: Depending on the selected measurement mode, the number of available functions and ease of operation may vary.

3) Self-checking and Self-correcting

When the instrument is powered on, it automatically performs an initialization sequence that includes both self-checking and wavelength correction procedures. The self-checking function verifies the operational status of key components, including:

- Online communication status
- Excitation light source
- Database module
- DAC (Digital-to-Analog Converter) module
- PMT (Photomultiplier Tube) module
- Motor module

Diagnostic results are shown on the LCD screen or, when connected to a computer, in the software interface. Wavelength correction ensures accurate alignment for precise measurements.

9. Operations

9.1 Operation of the Instrument Panel

1) **Display Window**
The display window is a 128×64-pixel LCD screen that provides real-time information, including:
- Initialization status
- Fluorescence value
- Concentration value
- Emission wavelength
- PMT (Photomultiplier Tube) level
- Concentration factors
- Standard concentration

2) **Display Symbols:**
- "●" indicates that the excitation light source is on.
- "%" indicates that the fluorescence value has been normalized.

3) **Function Key Operations**

"Mode" Key: Used to switch between different operation modes in the following sequence:
Fluorescence Value Mode → Wavelength Mode → PMT Level Adjust → Concentration Input Mode → Factor Input Mode → Concentration Mode → (back to) Fluorescence Value Mode. In Wavelength Mode and PMT Level Adjust, if a new parameter is set but not confirmed, pressing the "Mode" key cancels the change and restores the previous value.

"Print" Key: In Fluorescence Value Mode and Concentration Mode, this key prints the current values (requires a compatible serial printer). In other modes, the key is used to confirm parameter changes.

"Adj 0" Key: In Fluorescence Value Mode, sets the current fluorescence value to zero. In Wavelength Mode, Concentration Input Mode, and Factor Input Mode, it is used to navigate and select digits from left to right for editing. In PMT Level Adjust Mode, it decreases the PMT level.

"Normalize" Key: In Fluorescence Value Mode, normalizes the current value to 100 and displays the "%" symbol. Pressing again cancels normalization. In Wavelength Mode, Concentration Input Mode, and Factor Input Mode, it cycles through numbers 0–9 for digit entry. In PMT Level Adjust Mode, it increases the PMT level.

9.2 Startup Requirements for Normal Operation

1) **Powering On:** Begin by switching on the power source for the xenon lamp, followed by turning on the main power for the Fluoro spectrophotometer. Once activated, the xenon lamp requires a warm-up period of at least 30 minutes to stabilize before precise measurements can be taken.

Important Notes:
If the xenon lamp fails to ignite and produces a continuous high-frequency squealing or sparking noise, immediately switch off the xenon lamp's power. Wait a few seconds, then try turning it on again. This issue may occur if:

- The power supply is unstable or insufficient.
- The xenon lamp is nearing the end of its service life.

To prolong the lifespan of the xenon lamp, avoid unnecessary power cycling. Repeated switching on and off, especially under high voltage, should be minimized.

2) **Heat Dissipation Fan Check:** After powering on the instrument, verify that the side-mounted heat dissipation fan is running. Proper fan operation is essential for maintaining optimal internal temperature and ensuring stable performance. If the fan is not functioning properly, shut down the instrument immediately and arrange for maintenance.

3) **System Initialization:** Upon startup, the instrument automatically enters its initialization phase, which includes self-checking and wavelength correction. If not connected to a computer, the initialization status will be displayed on the instrument's LCD. If connected to a computer, the status will appear in the software interface, and the LCD will show "Online".

ST		PA	Failure
Self-checking	Self-Online	Online mode	Single mode
	Database module	Database initialized	Parameters error chip
	DAC module	DAC module initialized	DAC module chip error
	PMT module	PMT module initialized	Photomultiplier tube error PMT Module
	Motor module	Motor module initialized	Motor error
			Motor driver board
Self-correction	Wavelength correcting	The value from bottom to top and bottom again shows a wave peak.	No obvious wave peak.
			Wavelength error.

9.3 Instrument Operation

9.3.1 Measurement

After allowing the instrument to preheat for 30 minutes, it is ready for use. The measurement procedures vary slightly depending on whether you are using:

- Standalone mode (using the instrument alone), or
- Online mode (connected to a computer).

This section focuses on quantitative analysis using the standalone instrument.

1) **Filling the Sample Cell:** Pour the sample solution into the quartz sample cell until it reaches approximately two-thirds of its height. Wipe any residual liquid from the outside of the cell with filter paper to ensure optical clarity. Carefully place the cell into the sample cell holder.

Note: The sample cell is made of quartz. Handle with care to avoid damaging the transparent window. Always hold the cell at a diagonal angle using your fingers to avoid direct contact with the optical surface.

2) **Quantitative Analysis Using the Standalone Instrument**
This method is typically used for quantitative measurements and includes two approaches:
- Multipoint Standard Method
- Single-Point Standard Method

Below are the procedures for the Multipoint Standard Method.

9.3.2 Multipoint Standard Method

1) **Prepare Standard Solutions:** Create a series of standard solutions of known concentrations, including a blank solution, & prepare an unknown sample for test.

2) **Wavelength Adjustment:** Press the “Mode” key to enter Wavelength Mode. The screen will display "Current Wavelength: nm". Use the “Adj 0” or “Normalize” key to set the desired wavelength. Press “Print” to confirm and set the wavelength.

3) **PMT Level Adjustment:** Press the “Mode” key to enter Fluorescence Value Mode. Insert the standard solution with the highest concentration into the sample holder. Press “Mode” again to access PMT Level Adjust Mode. The display will show "Current PMT Level". Use the “Adj 0” or “Normalize” key to adjust the sensitivity. Press “Print” to confirm and set the PMT level. Adjust the PMT level so the fluorescence value for the highest concentration standard falls between 200–400.

4) **Zero Adjustment:** Place the blank solution in the sample holder. Enter Fluorescence Value Mode by pressing “Mode.” Wait until the reading stabilizes. Press “Adj 0” to set the fluorescence value to zero (±0.1).

⚠ **Note:** Do not perform zero adjustment during subsequent measurements.

5) **Measurement of Standard Sample:** Place each standard solution (from the lowest to the highest concentration) into the sample holder one by one. Wait for the fluorescence value to stabilize. Record each value. Use Microsoft Excel (Data Processing with Microsoft Excel 2000) to fit a calibration curve equation.

6) **Measurement of an Unknown Sample:** Place the unknown sample into the sample holder. Once the reading is stable, record the fluorescence value. Use the previously generated working curve equation to determine the sample concentration.

9.3.3 Single-Point Standard Method

Prepare the following:
1) One standard solution
2) One blank solution
3) The unknown sample solution

Note: The concentration of the standard solution should be as close as possible to that of the unknown sample.

1) **Wavelength Adjustment:** Press “Mode” to enter Wavelength Mode. The screen will display; "Current Wavelength, nm". Use “Adj 0” or “Normalize” to set the desired wavelength. Press “Print” to confirm the setting.

2) **PMT Level Adjustment:** Enter Fluorescence Value Mode using the “Mode” key. Insert the standard solution into the sample holder. Press “Mode” again to enter PMT Level Adjust Mode. Adjust the PMT level using “Adj 0” or “Normalize” to achieve a fluorescence value between 200–400. Press “Print” to confirm.

3) **Zero Adjustment:** Insert the blank solution into the sample holder. In Fluorescence Value Mode, wait for the value to stabilize. Press “Adj 0” to zero the fluorescence value (±0.1).
   ⚠ **Important:** Do not perform zero adjustment again during the same measurement session.

4) **Input Standard Concentration:** Press “Mode” to enter Concentration Input Mode. When the screen shows "Input Concentration:", adjust the value using “Adj 0” or “Normalize” to match the concentration of the standard solution. Press “Print” to compute the concentration factor and switch to Concentration Mode.

5) **Measurement of Unknown Sample:** Insert the unknown sample into the sample holder. The display will show the sample concentration directly. Press “Print” to print the result if a compatible serial printer is connected.

6) **Read and Adjust Concentration Factor:** Press “Mode” to enter Factor Input Mode. The display will show "Input Factor:" along with the current concentration factor. Adjust this value as needed using “Adj 0” or “Normalize”.
   Note: When measuring the same type of sample repeatedly, you may use the stored concentration factor to directly measure without recalibration—ensure that the PMT level matches that used during factor setup.

9.3.4 Shutdown Procedure

To properly shut down the instrument:

1) **Standalone Mode:** Turn off the main unit of the Fluoro spectrophotometer. Then turn off the xenon lamp power source.
2) **Online Mode (Connected to a Computer):** Close the control software. Turn off the main unit. Finally, switch off the xenon lamp.

⚠ **Important:** After switching off the xenon lamp, wait at least 60 seconds before turning it back on to avoid damaging the lamp.

10. Software Operations

10.1 Requirements for Software Usage

Before proceeding with this section, “Operation Instruction for the Instrument” in Part Two, as well as the user manuals for the supported versions of Windows 98.

Basic Configuration Requirements for Computer Hardware and Software

1) **Hardware Requirements**
   CPU: Intel Pentium II or Celeron 600 MHz or higher
   Memory: Minimum of 64 MB RAM
   Hard Drive: At least 200 MB of available storage space
   Serial Ports: Two functional serial ports with no system conflicts or interruptions
   Display: Minimum resolution of 800×600 pixels with color depth of at least 16-bit

2) **Software Requirements**
   Operating System: Windows 98 Second Edition (other versions of Windows 98 are also supported)
   System Settings: Disable the screen saver power management features. These settings are necessary to ensure the proper functioning of the Fluoro spectrophotometer Data Processing Software Package (hereafter referred to as "Software").

10.2 Software Installation Instructions

1) **Insert the Installation CD-ROM:** Place the CD-ROM into your computer's CD drive. The installation process should start automatically.

2) **Manual Installation:** If the installation does not begin automatically:
   Open “My Computer” or “This PC”. Navigate to the CD drive (e.g., X:\). Double-click on the file named SETUP.EXE to launch the installer

3) **Installation Process:** When the Setup window appears, click the "NEXT" button. When prompted, click "NEXT" again Installation Path dialog box will appear:
   To accept the default location, click "NEXT." To change the location, click "Browse", select your preferred directory, then proceed.

4) **Item Name dialog box will appear:** The default name is “The Software Package of Fluoro spectrophotometer”. The user can accept it by clicking "NEXT" or enter a different name.

5) **Final Steps:** Review the settings, if changes are needed, click the "< Back" button. When ready, click "NEXT" to begin installation. The system will now install the software from the CD-ROM. After installation is complete, restart the computer to ensure proper operation.

   Important Note: The CD-ROM and the instrument it is paired with share a unique serial number. This software must only be used with the corresponding instrument.

10.3 Preparation before Use

1) **Connecting the Main Unit to a Computer:** The main unit connects to a computer via a USB port. When connected for the first time, the USB driver will automatically install. After the driver installation is complete, you can run the software.

2) **Connect via USB Cable**: Use a USB cable to connect the main unit to your computer.

3) **Power on the Instrument:** First, switch on the Xenon Lamp. Once the Xenon Lamp is fully lit, power on the main unit. The system will automatically detect the connection and enter online mode.

4) **Initialization:** The software will check the connection and begin initialization. Do not place any sample in the sample compartment during this step. Once initialization is complete, the Wavelength Scan interface will appear

5) **Switching Between Working Modes:** Click on **"Working Mode"** in the menu bar Choose from the three available modes:
   - Wavelength Scan
   - Time Scan
   - Quantitative Analysis

6) **Powering Off in Online Mode:** Always close the software first before turning off the main unit. If the main unit is turned off before the software is closed, a communication error may occur. In case of such an error, open the Task Manager and manually end the process.

   Important Note: To ensure proper function and avoid software issues, always follow the correct power-on and power-off procedures.

10.4 Operation of Software

1) **Connecting the Main Unit to a Computer:** The main unit connects to a computer via a USB port. When connected for the first time, the required USB driver will be installed automatically. Once the installation is complete, launch the software.

2) **Steps for Starting an Online Operation:** Connect the USB Cable. Use the provided USB cable to connect the main unit to your computer.

3) **Power on the unit:** First, turn on the xenon lamp. Once the lamp is fully lit, turn on the main power of the instrument. The system will automatically detect the connection and switch to online mode.

4) **Initialize the Software:** The software will verify the connection and begin initialization. Do not place any sample in the sample compartment during this process. Upon successful initialization, the Wavelength Scan Mode interface (Fig. 2-1) will appear.

5) **Selecting a Working Mode:** Click "Working Mode" on the menu bar in the main interface. Choose from one of the three available modes.
   - Wavelength Scan
   - Time Scan
   - Quantitative Analysis

6) **Shutting Down from Online Mode:** To properly exit online mode, turn off the power to the main unit

   ⚠ **Warning:** If the main unit is turned off before the software is closed, a communication error may occur. If an error does occur, open task manager and manually end the process.

   Reminder: Always follow the correct startup and shutdown procedures to avoid system errors and ensure smooth operation.

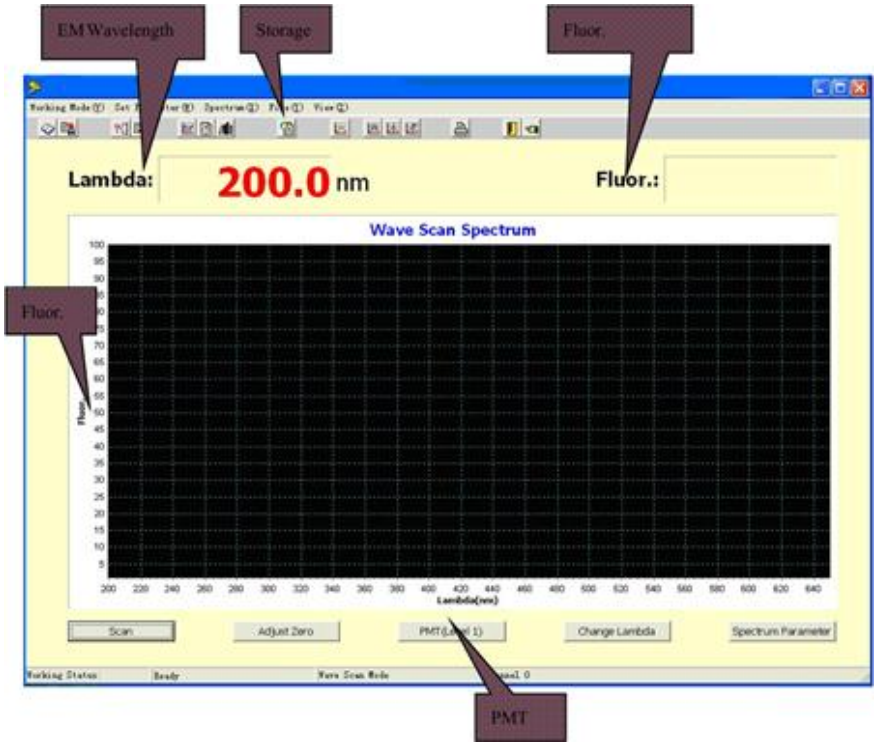

Figure-11 (Interface of Wavelength Scan)

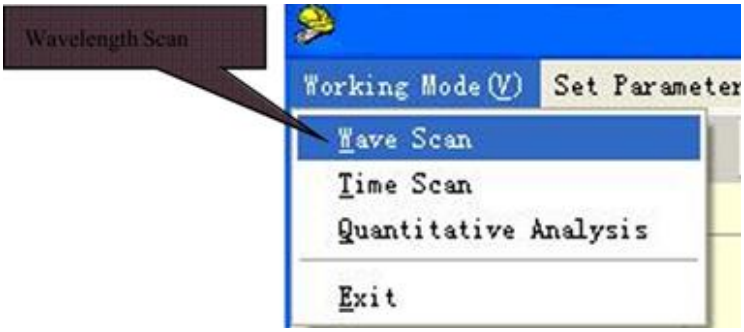

Figure-12 (Switchover of Working Mode)

Three Interfaces of Working Modes

Three primary interfaces correspond to different working modes in fluorescence analysis: Wavelength Scan, Time Scan, and Quantitative Analysis.

1) **Wavelength Scan Interface:** The Wavelength Scan mode involves measuring the fluorescence intensity as a function of emission wavelength, under a fixed excitation wavelength (excitation source). This process generates the fluorescence spectrum of a sample. This mode is useful for selecting an appropriate emission wavelength for quantitative fluorescence analysis. It also aids in studying the emission behaviour of fluorescent molecules in solution.

2) **Time Scan Interface:** The Time Scan mode involves monitoring how the fluorescence intensity of a sample changes over time at a specific emission wavelength, under a fixed excitation wavelength. This mode is commonly used for kinetic studies, optimization of experimental conditions for quantitative fluorescence analysis, and assessment of instrument drift and noise.

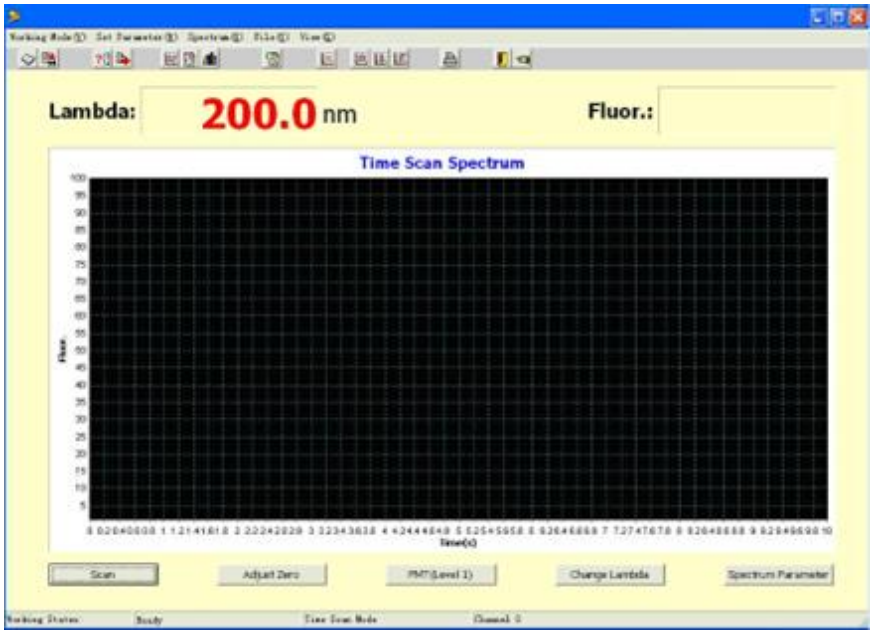

Figure-13 (Interface of Time Scan)

Time scan differs from wavelength scan in that the unit of abscissa is time during scanning. In the functions such as “Set Parameter”, “Spectrum”, “File”, operation, the requirements for time scan are the same as those for wavelength scan.

3) **The Interface of Quantitative Analysis:** Quantitative analysis means that in the conditions of selected excitation source (namely at excitation wavelength) by measuring the fluorescent emission intensity (F) of the component (its unknown concentration C) to be determined, from the formula F=KC, the concentration of the component to be determined is acquired. K in the formula is a constant related to the test conditions, and it can be acquired by measuring the fluorescent emission intensity of a standard solution of the component to be determined, and then calculating it under the same test conditions.

The fluorescent emission intensity of many standard solutions it can also be acquired by linear fitting or the graphical solution method. Quantitative analysis can be used to measure the content of the component emitting fluorescence in the sample solution.

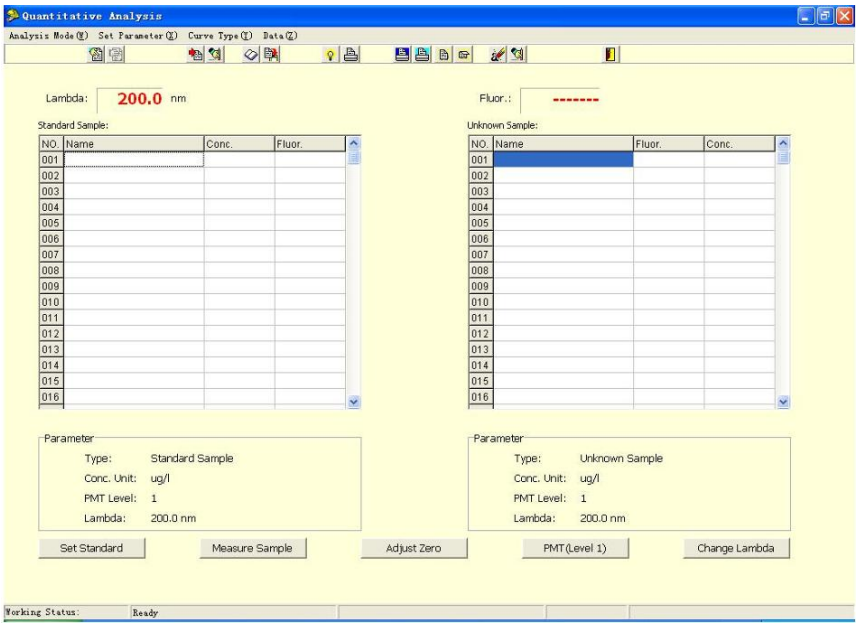

Figure-14 (Interface of Quantitative Analysis)

10.5 Wavelength Scan Mode

On completion of initialization for the instrument, the interface of the wavelength is immediately displayed. The first row at the top of the screen is the Menu Bar. In the second row are 15 “Shortcut Icons”. On the screen are the wavelength, the display window of fluorescence, and the coordinate graph with fluorescence value and wavelength. At the bottom of the screen, there are 5 “Shortcuts”.

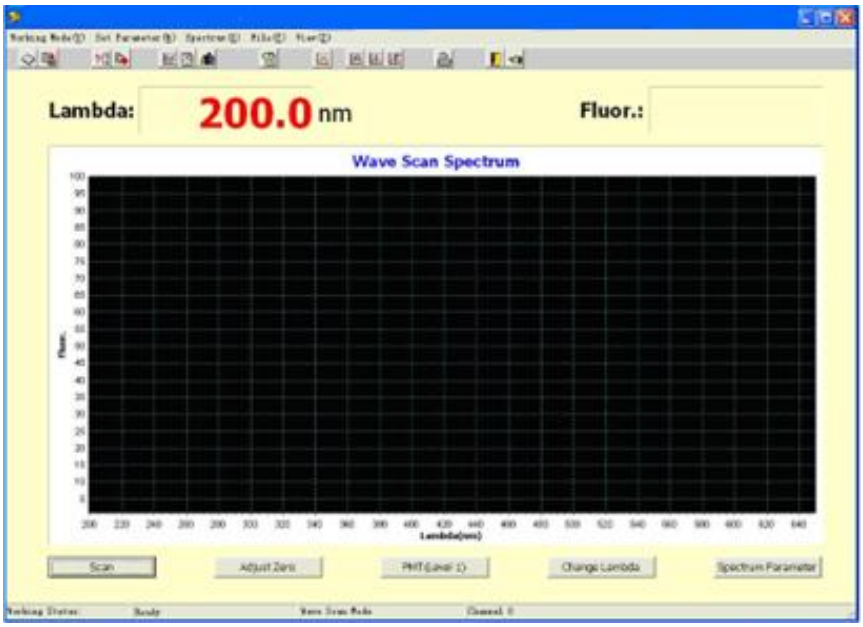

Figure-15 (Interface of Wavelength Scan of Fluorescence Spectrum)

The Functions of Shortcuts at the Bottom of the Screen

1) **"Scan"** is the button for starting. After you click it, it scans a spectrum according to the parameters set.
2) **"Adjust Zero"** is the button for zero adjustment of the current value. It is used to deduct a background value.
3) **"PMT (Level 1)"** is the button for PMT level adjustment. Select a proper PMT level (1-17) in the pop-up window. Then click OK.
4) **"Change Lambda"** is the button for adjusting the current wavelength. The instrument's main unit will automatically change the current wavelength to the wavelength set.
5) **"Spectrum Parameter"** is the button to show the parameters of the current wavelength scan.

Functions of Shortcut Icons: When the mouse pointer is moved onto a shortcut icon, the function of the shortcut icon will show. Icons are arranged in order from left to right. The functions are described below.

 : "Load Spectrum" button means to open a previously saved spectrum.

 : "Save Spectrum" button means to save the current spectrum.

 : "Transmit Spectrum" button means to transmit a spectrum between the channels.

 : "Transmit Parameter" button means to transmit the spectrum parameters in the current channel to other channels.

 : "Wave Scan" button means to switch the current working mode to wavelength scanning mode.

 : "Time Scan" button means to switch the current working mode to time scanning mode.

 : The "Quantitative Analysis" button means to switch the current working mode to quantitative analysis mode.

 : "Parameter" button means to set scan parameters.

 : "Restore Parameter" button means to restore the spectrum of current channel to its original status.

 : "Smooth" button means to carry out the operation of average value for the spectrum data, so that the spectrum becomes smoother.

 : "P/V Detection" button means to detect the values of the valley & peak of a spectrum.

 : "ShoSw P/V Data" button means to display the values of peak & valley in a spectrum after peak & valley detection.

 : "Print" button means to print out a spectrum and data.

 : "Exit System" button means to close the Software.

 : "Locate Lambda to print" button means to select a wavelength you need for printing out.

Menu Bar at the Top of the Screen

"Working Mode": After clicking it with the mouse left button, from the pull-down menu select a change of working mode or exit from the program. The other items on the menu bar are "Set Parameter", "Spectrum", "File", and "View".

Wavelength Scanning Operation: Fluorescence spectrum can be acquired by wavelength scan, and the wavelength of fluorescent measurement used for quantitative analysis can be determined from the fluorescence spectrum.

Parameter Setting: On completion of initialization of the instrument, the interface of the wavelength scan appears immediately. Before the scanning operation, you need to set the scanning parameters first. After clicking "Set Parameter", the interface of "Wavelength Scan Parameter" will appear.

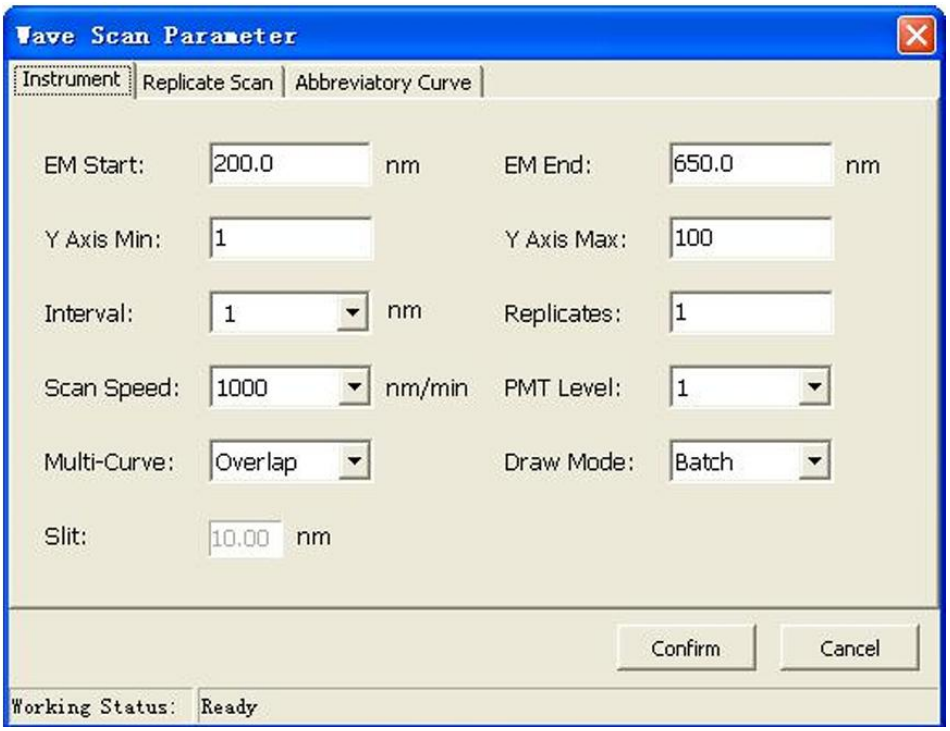

Figure-16 (Interface of wavelength scan parameter)

EM Start: Set the start wavelength of the scan.
EM End: Set the end wavelength of the scan.
Y Axis Min: Set the minimum of the Y-axis in the scan spectrum.
Y Axis Max: Set the maximum of the Y-axis in the scan spectrum.
Interval: Set the data interval of the wavelength scan.
Replicates: Set the number of scans.
Scan Speed: The value automatically changes with the wavelength interval.
PMT Level: Set the PMT level of the time scan.
Multi-Curve: Set the display mode of curves. "Overlap" shows different curves in the same window. "Overlay" will cover the last time scan curve, and show the latest.
Draw Mode: Set the plot mode of the wavelength scan. "Real Time" will show the current data of wavelength scan. "Batch" will show all data after wavelength scan.
Slit: Its value is unchangeable and it has a bandwidth of 10 nm.

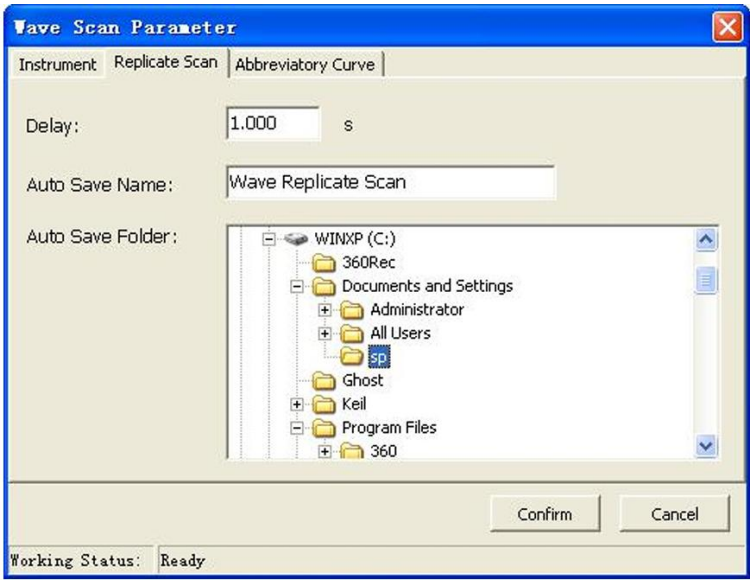

Figure-17 (Replicate Scan settings)

Delay: Set the Delay between two scans.
Autosave Filename: Edit the filename of the spectrum. The software will automatically add the current time of the scan after the filename.
Autosave Position: Set the autosave position on your computer.

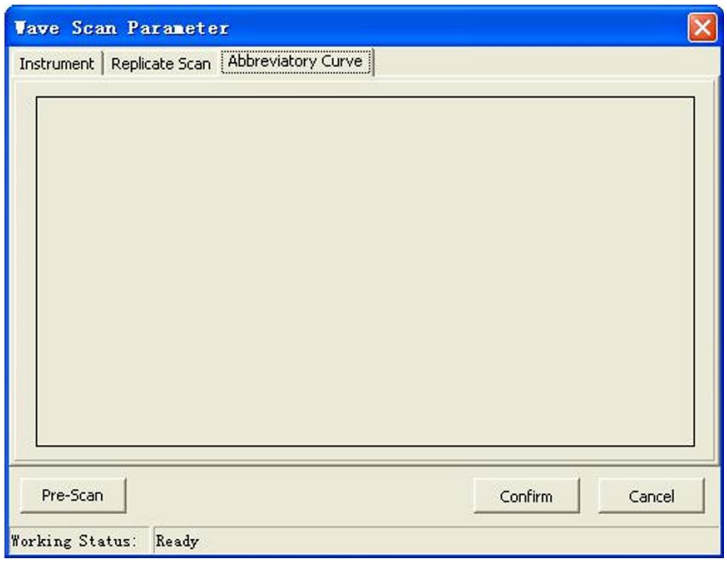

Figure-18 (Abbreviatory Curve)

Pre-Scan: It's a fast scan according to "Basic Settings" in "Wavelength Scan Parameter". After a Pre-Scan, a thumbnail is created, and the proper Y axis will be automatically set.
Spectrum Processing: Clicking the "Spectrum" button from the Menu Bar presents a pull-down sub-menu.
Zoom: This means to reduce or enlarge a spectrum. After clicking this item, you only need to input the scale data of a new spectrum. For enlargement, you may directly use the mouse to drag the spectrum on the screen.

The method is to drag in the direction from the top left side of the spectrum to the bottom right side of the spectrum. If you want to return the enlarged spectrum to the original one, you may drag it in the opposite direction.

Differential Coefficient: This means to differentiate concerning the spectrum. The 1st-4thorder of derivative operation on the spectrum is performed. The set value of the derivation interval must be twice the value of the scan interval.

Restore: The spectrum may be restored to the original one of the Spectrum Menu

Smooth: This means to perform a calculation on the average value for each point of the spectrum to make the spectrum smoother.

P/V Detection: It is used to detect the values of peaks and valleys of a spectrum. Click this item, and the "Input Sensitivity" dialog box will appear. Input a limited value of "Input Sensitivity" as a value of available peaks. All peaks above the limited value can be detected. For example, if the value of "Input Sensitivity" is 25, a peak value of 50 can be detected. If the value of "Input Sensitivity" is 60, a peak value of 50 cannot be detected. Then click "Show P/V Data" on the sub-menu, and the values of peaks & valleys will be displayed.

Arithmetic: Click "Arithmetic" in the interface of "Arithmetic" will open. This calculation can be used as the operation between a single channel and constants, and can also be used as the arithmetic operation between channels.

10.6 Time Scanning Mode

Interface and Operation of Time Scanning: Mode Time scan differs from wavelength scan in that the unit of the X-axis is time during scanning. This working mode can be used to observe the situation in which the fluorescent intensity of a sample varies with time at a fixed emission wavelength.

Interface of Time Scanning: Mode Click "Working Mode" in the menu bar. Then click "Time Scan" in the pull-down sub-menu, and the interface of wavelength can be changed to the interface of time scan. The time scan interface is the same as that of the wavelength scan interface except for the unit of the X-axis. The functions of the shortcuts are also the same. Click "Parameter Settings" to enter Time Scan Parameter Settings.

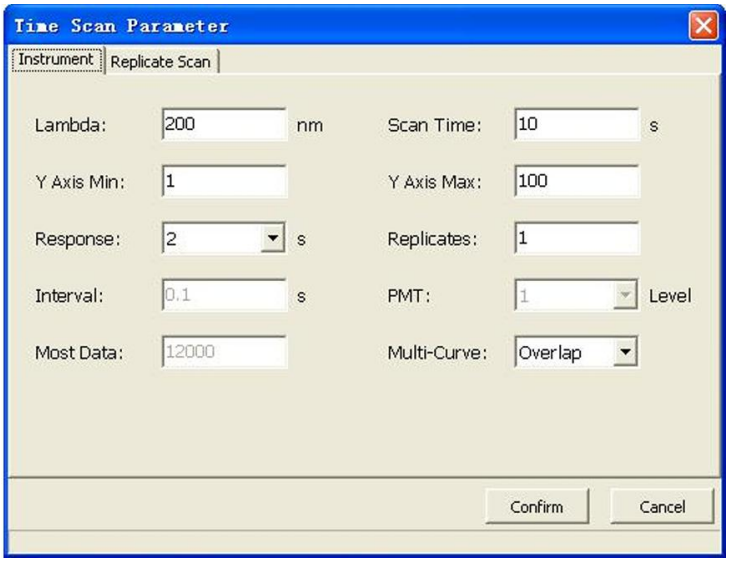

Figure-19 (Time Scan Parameter Settings- Instrument)

Lambda: Set the emission wavelength of the time scan.
Scan Time: Set the total scan time.
YAxis Min: Set the minimum of the Y axis in the scan spectrum. 4 YAxisMax.Set the maximum of the Y axis in the scan spectrum.
Response: Set the signal integral time of the time scan.
Replicates: Set the number of scans.
Interval: Set the update interval of the time scan. Update every 0.1 second.
PMT: Set the signal PMT level of the time scan.
Most Data: Set the maximum sample size of the time scan.
Multi-Curve: Set the display mode of curves. "Overlap" shows different curves in the same window. "Overlay" will cover the last time scan curve, only showing the latest.

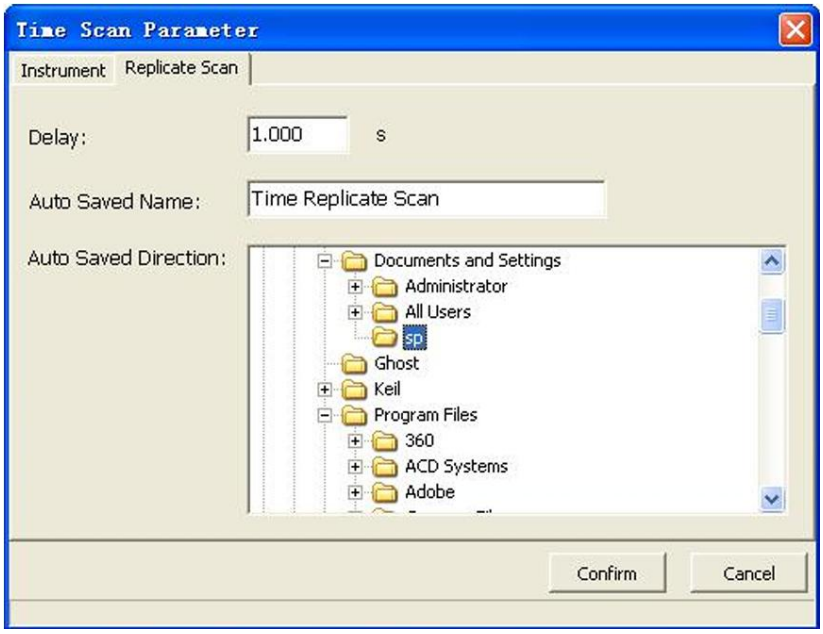

Figure-20 (Replicate Scan)

Delay: Set the delay time between two scans.
Auto Saved Name: Edit the filename of the spectrum. The software will automatically add the current time of the scan after the filename.
Auto-Saved Direction: Set the autosave position on your computer.
Spectrum Processing: The functions and the operation are the same as those of spectrum processing in wavelength scanning mode.
Storage Processing: The functions and the operation are the same as those of spectrum processing in wavelength scanning mode.
Display Setting: The functions and the operation are the same as those of spectrum processing in wavelength scanning mode.

10.7 Quantitative Analysis Mode

Interface of Quantitative Analysis Mode: Click "Working Mode" on the upper left screen. The interface of the quantitative analysis mode from the pull-down menu will appear.

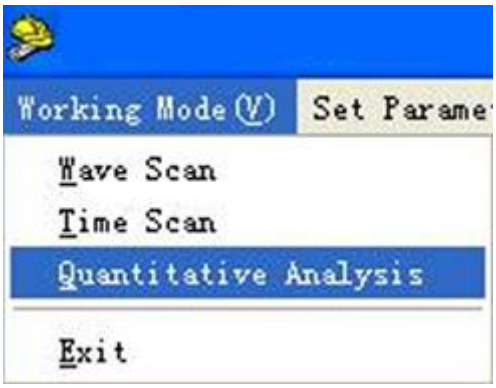

Figure-21 (Entering the interface of Quantitative Analysis)

Above the interface of quantitative analysis on the top of the screen, the first row is a menu bar. The second row has 15 icons. The screen shows the Current Wavelength (Lambda), Fluorescence Value (Fluor.), and boxes of Standard Sample and Unknown Sample. On the bottom of the screen, there are 5 buttons.

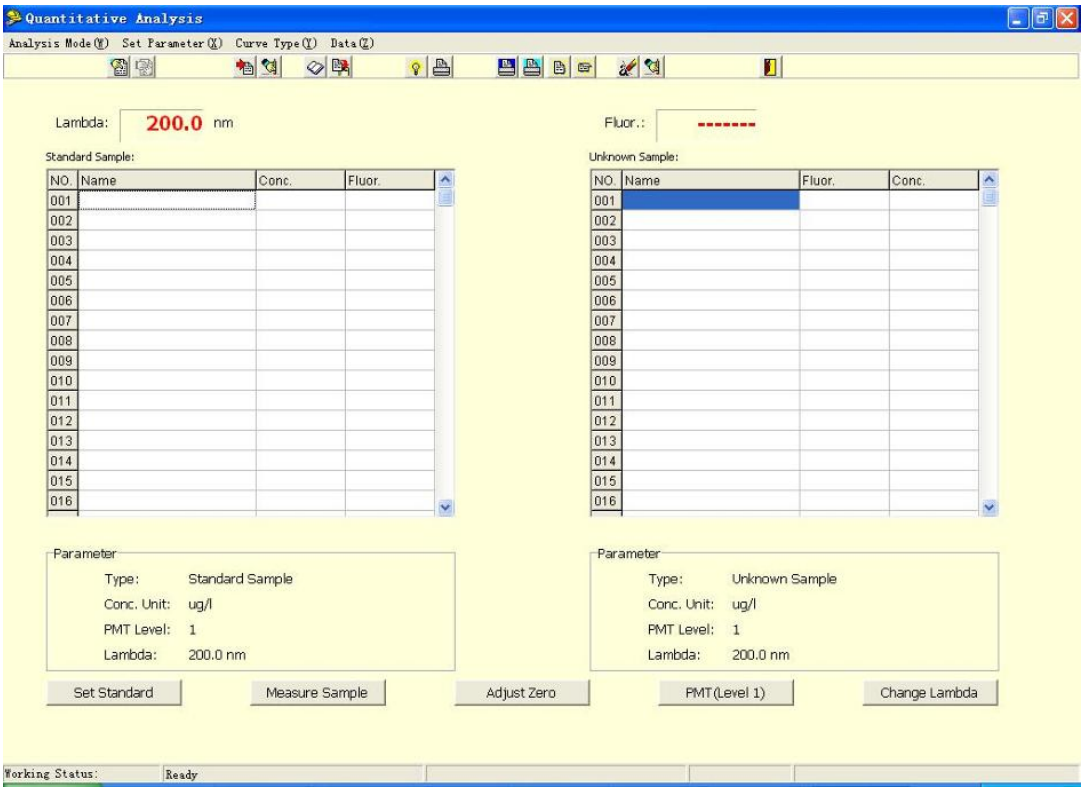

Figure-22 (Shortcuts in the Interface of Quantitative Analysis)

Functions of Shortcuts at the Bottom of the Screen

1) **Set Standard:** Used to define the standard sample. Clicking this button opens the “Set Standard Sample” dialog box.
2) **Measure Sample:** Used to measure a sample. Once clicked, the measured fluorescence value and its corresponding concentration are displayed in the "Display Box of Sample Measurement."
3) **Adjust Zero:** Performs a zero-point adjustment to subtract background values from the measurement.
4) **PMT:** Allows adjustment of the Photomultiplier Tube (PMT) level. In the pop-up window, select a PMT level (ranging from 1 to 17) and click "OK."
5) **Change Lambda:** Used to change the current wavelength shown at the top of the screen. Upon clicking, the instrument automatically adjusts to the set wavelength.

Functions of Icon Shortcuts: When hovering the mouse pointer over an icon shortcut, a tooltip describing its function will appear. The icons are arranged from left to right, with the following functions:

1) **Set QA Parameter**: Currently not active.
2) **Set Working Curve Parameter:** Allows direct input of coefficients to define a working curve equation. Only available in coefficient input mode.
3) **Calculate Coefs.:** Generates a working curve equation by measuring standard samples.
4) **Input Coefs:** Enables direct input of coefficients to define a working curve equation.
5) **Load Spectrum:** Feature not yet activated.
6) **Save Spectrum:** Feature not yet activated.
7) **Build Curve:** Constructs a standard working curve equation.
8) **Print Curve:** Prints the currently generated working curve.
9) **Print Std. Data:** Prints data related to standard samples.
10) **Print Spl. Data:** Prints data related to measured samples.
11) **Load QA File:** Loads a previously saved quantitative analysis (QA) file.
12) **Save QA File:** Saves the current quantitative analysis file.
13) **Clear Std. Data:** Clears all standard sample data.
14) **Clear Spl. Data:** Clears all sample data.
15) **Exit QA:** Exits the quantitative analysis mode.

Operation of Quantitative Analysis: The interface of quantitative analysis. On the left is the display box of the Standard Sample, and on the right is the display box of the Unknown Sample.

Setting of Fluorescence Wavelength for Measurement: Click “Set Standard” below. Input the value of fluorescence wavelength of the sample to be measured, then click “OK.”

PMT Setting: There are 17 grades (1-17). The default PMT level is 1. Generally adjust the PMT level by using the highest concentration of the solution. Adjust the fluorescence value to make sure it is stable within the range of 300-400.

Zero-point Adjustment: Place the blank solution into the light path. Click the "Adjust Zero" button. At this time, the fluorescence value on the upper right of the interface becomes 0.0.

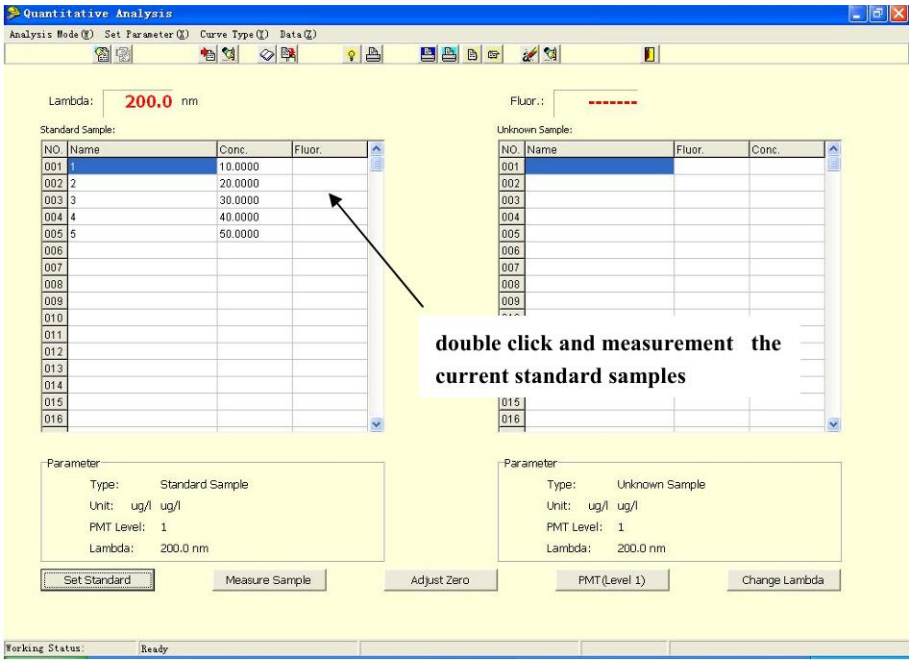

Figure-23 (Interface of Quantitative Analysis)

Standard Sample Setting: After clicking the "Set Standard" shortcut on the bottom left of the interface of quantitative analysis, a dialog box of "Set Standard Samples". The concentration unit can be set in the "Unit" box. If there are 5 standard samples and their concentrations are 10 for the No.1 sample, 20 for the No.2 sample, 30 for the No.3……., respectively. After inputting "1" in the "Name" and "10" in the "Concentration", click the "Add" button. The data input will be displayed in the box below. Repeat the above operation for 5 times. Use the "Insert" and "Delete" buttons to edit your sample data. The data will be displayed in the "Standard Samples" box in the interface of quantitative analysis.

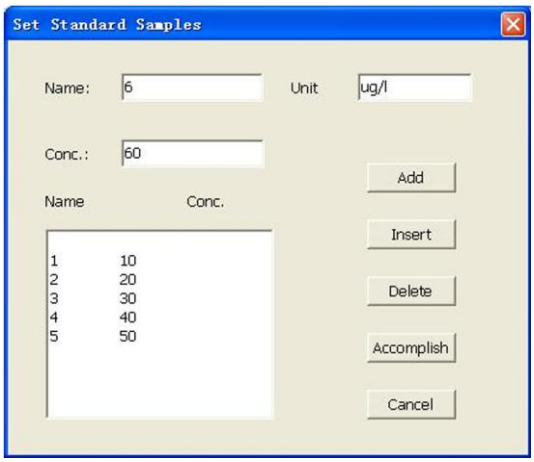

Figure-24 (Dialog Box of Set Standard Samples)

Note: The parameter setting of standard samples must follow the order of concentration from low to high. The names of standard samples (including sample names) can be set for English alphabet, or characters.

Measurement of Standard Samples: In the "Standard Samples" in the interface of the quantitative analysis interface, 5 rows of data for standard samples input in are listed respectively. When measuring, put the No.1 standard sample into the sample compartment. Then double-click the row of the No.1 standard sample. The display of "Under Measurement" will appear at the bottom of the interface. A few seconds later, the fluorescence value (F) will be displayed. Repeat the above procedures until the fluorescence values of all standard samples are measured.

Method of Undetermined Coefficients: Click "Curve Type" in the menu bar. Select the type of curve that you need in the pull-down sub-menu (The default setting is a linear curve.). Then click "Data" in the menu bar and select "Build Curve" in the sub-menu. A "Working Curve Window" will appear on the screen, and a working curve of the standard sample will be plotted. Below the working curve, there is an equation of the working curve and a correlation coefficient. The method as described above, by which an equation of the working curve is created through measurement of standard samples, is called the Method of Undetermined Coefficients. If an equation of the working curve is known, you may select "Input Coef.". As for the measurement of samples by the method of inputting a coefficient.

Measurement of Samples: After placing the sample into the sample compartment, click the "Measure Sample" shortcut on the bottom of the screen. The fluorescence value and the corresponding concentration value of the sample will be displayed in the display box of the sample measurement.

Set Sample Name: Click one grid of "Sample Name" in the "Unknown Sample" box to edit the name of the selected sample

11. Maintenance

11.1 Routine Maintenance

To ensure consistent performance and extend the service life of the Fluoro spectrophotometer, follow these routine maintenance practices.

1) **Verify Working Conditions:** Regularly check that the operating environment meets the specified requirements. If any condition falls outside the acceptable range, take corrective action immediately to prevent performance issues or damage.

2) **Ensure Proper Ventilation:** While the instrument is in operation, maintain unobstructed airflow around the heat dissipation vents located at the top of the unit. Avoid placing objects near or on top of the instrument that could block ventilation.

   ⚠ **Caution:** The heat dissipation area can become extremely hot during operation. Do not touch it to avoid burns.

3) **Maintain Cleanliness:** Always keep the instrument clean and free of dust. When the unit is not in use, cover it with a dust-proof cover. To clean the external surfaces, use a soft cloth dampened with warm water. Do not use organic solvents such as alcohol, ether, or acetone, as they may damage the surface. Never attempt to clean the instrument while it is powered on.

4) **Clean the Sample Cell:** The sample cell should be thoroughly cleaned before and after each use. Residues can significantly affect measurement accuracy and reliability.

11.2 Light Source Lamp

The Fluoro spectrophotometer uses a high-performance xenon lamp as its light source, housed in a specially designed lamp chamber. To ensure optimal performance and longevity of the lamp, follow these maintenance guidelines:

1) **Keep the Lamp Surface Clean:** Ensure the xenon lamp's surface remains free of dust and fingerprints, as contamination can affect its light output and performance. Follow the proper Power-On and Power-Off Sequence. Always adhere strictly to the correct operating sequence when turning the xenon lamp on or off.

2) **Startup Sequence:** Turn on the xenon lamp power source. Wait for the lamp to ignite and stabilize. Then, power on the main unit of the instrument.

3) **Shutdown Sequence:** Turn off the main unit first. Then turn off the xenon lamp power source.

   ⚠ **Note:** Failure to follow the correct sequence may damage the lamp or the instrument.

4) **Handle Power Instability Carefully:** If the power supply is unstable or near the end of the xenon lamp's service life, ignition may become difficult. If the lamp fails to ignite and you hear a high-pitched squeak or sparking/crackling sounds, immediately turn off the lamp's power. Wait several seconds, then try to turn it on again.
   ⚠ **Note:** Frequent failed ignition attempts may indicate a degraded lamp or insufficient power capacity.

5) **Avoid Frequent On/Off Switching**
   To extend lamp life: Minimize the number of times the lamp is switched on and off. Avoid turning the lamp on and off repeatedly or rapidly, especially under high voltage.
   ⚠ **Important:** The lamp's lifespan is directly affected by the number of power cycles.

6) **Ensure Proper Ventilation:** After startup, confirm the heat dissipation fan is operating normally. The top surface of the instrument must remain well-ventilated. Do not block or obstruct the ventilation openings.

7) **Replacement of the Light Source Lamp:** The xenon lamp is part of a precision-calibrated light source assembly, pre-adjusted at the factory. Replacement must only be carried out by qualified personnel.
   ⚠ **Important:** Replacing the xenon lamp involves alignment and recalibration. A trained technician must perform this procedure. Instruction and training will be provided if needed.

11.3 Filter

1) **Maintenance of the Filter:** The surface of the filter should be kept clean.
   Note: If you have touched the surface of the filter, please wipe it clean with a piece of lens tissue and alcohol, then dry it.
   The filter stripped down must be cleaned and then wrapped up with lens tissue. After that, it should be put into a container holding desiccant and well preserved.

2) **Replacement of Filter:** Remove the cover of the sample compartment. Unscrew the knurled screw which is on the right side of the excitation part. Open the cover board on the excitation part from the top left of the knurled screw. Take out the excitation part. Remove the front pressing ring of the excitation part anti-clockwise. After that, hold both sides of the filter edges with your fingers and take it out. Then place a new one into the pressing ring. (There are no obverse and reverse sides for a filter.) Screw the pressing ring into the filter position in the front of the sample compartment clockwise and screw it tightly.
   Note: When taking the filter out, do not touch the filter surface of the light-transmission.
   Make sure the cover board is open. Then put the excitation part on the frame. Close the cover board. Tighten the screws.

12. Accessories

- Laser filter 365nm (1 PC)
- 10mm quartz colorimetric dish (1 PC)

Optional Accessories

- Glass Colorimetric dish,5mm
- Glass Colorimetric dish,10mm
- Glass Colorimetric dish,20mm
- Glass Colorimetric dish,30mm
- Glass Colorimetric dish,50mm
- Quartz two-way colorimetric dish,5mm
- Quartz two-way colorimetric dish,10mm
- Quartz two-way colorimetric dish,20mm
- Quartz two-way colorimetric dish,30mm
- Quartz two-way colorimetric dish,50mm
- Glass four-way colorimetric dish,10mm
- Quartz four-way colorimetric dish,10mm
- Quartz semimicro colorimetric dish,10mm
- Quartz micro chromatographic dish,200ml
- Quartz micro chromatographic dish,500ml
- Multi-function adapter
- Membrane sample holder
- Powder sample holder
- 10mm cell holder adapter
- Double frequency filter
- Peltier temperature control holder
- Up conversion laser head holder (fiber and laser generator not included)
- Laser filters 200nm-850nm
- Laser Source 255nm
- Laser Source 265nm
- Laser Source 280nm
- Laser Source 310nm
- Laser Source 325nm
- Laser Source 335nm
- Laser Source 345nm
- Laser Source 350nm
- Laser Source 365-525nm