

EQUIPMENT – BIOWORKSHOP, FISHELL DEPT OF BIOENGINEERING

The BioWorkshop in the Fischell Department of Bioengineering at the University of Maryland – College Park houses more than 20 instruments across four categories of applications:

1. Cellular and biochemical analysis

Amnis Imaging Flow Cytometer

The Amnis ImageStream®X Mark II Imaging Flow Cytometer combines the speed, sensitivity, and phenotyping abilities of flow cytometry with the detailed imagery and functional insight of microscopy. The ImageStream®X MKII systems deliver multi-channel images of every cell in flow, including brightfield, darkfield(SSC) and up to 6 fluorescent markers at high speed. Ultrasmall camera pixel size allows visualization of fluorescence location from the membrane, cytoplasm, subcellular organelles or nucleus at high resolution. The innovative design increases signal to noise ratio providing exceptional photonic sensitivity. A dedicated side scatter laser, adjustable laser intensities, and bright-field imagery allows the systems to resolve populations more effectively.

Applied Biosystems QuantStudio 7 Flex System

The QuantStudio 7 Flex Real-Time PCR System delivers reliable, sensitive, and accurate quantification with the versatility. It offers optimized protocols, reagents, and intuitive software for the broadest range of quantitative PCR applications. QuantStudio 7 can run hundreds of real-time PCR reactions using TaqMan Array microfluidic cards. Enabling improved well-to-well and instrument-to-instrument data accuracy, the OptiFlex™ System features six decoupled excitation and emission filter channels, with 21 filter combinations for maximum multiplexing and chemistry flexibility.

BD FACSCelesta

The BD FACSCelesta flow cytometer offers fast, versatile, accessible multicolor flow cytometry. Narrow dye and detector configurations minimize spectral overlap and simplifies experimental design and analysis, allowing simultaneous detection of up to 14 parameters using three lasers. The instrument also enables detection of low-density or rare populations through optimized photo-stable dyes. The BD FACSDiva™ software is available to streamline workflow from system setup to data acquisition to data analysis.

FreeZone 6 L Console Freeze Dryers

The FreeZone 6 L Console Freeze Dryer is designed for lyophilizing moderate to large sample loads or numerous small container batches. The system is equipped with a 12-port chamber. Two sizes of Fast Freeze flasks are available 600 mL and 900 mL. Interior PTFE coating provides corrosion resistance.

NanoDrop 2000c

The NanoDrop 2000c is a full-spectrum UV-Vis spectrophotometer equipped with both a sample-retention system for microvolume samples and cuvette measurement. Simplified software enables easy data collection.

ProteinSimple FluorChem E System Gel Imager

The FluorChem E from ProteinSimple features simplified touch screen control, straightforward workflow for detection of chemiluminescent, colorimetric and UV fluorescent gels and blots. A 8.3 megapixel, high-resolution CCD camera with 5-log dynamic range enables capturing both faint and bright bands in single exposure.

Tecan Spark Multimode Microplate Reader

The Tecan Spark high-content microplate reader offers Absorbance Mode, Top and Bottom Fluorescence Mode, Luminescence Mode, Fluorescence Polarization Mode, Brightfield Imaging, extended live-cell experiments, and well scanning. This multimode system is optimized for a wide range of life science research applications: ELISA, Low-volume DNA/RNA quantification, Nucleic acid labeling efficiency, Protein quantification, Reporter gene assays, Cell counting and viability, Confluence assessments, Cell migration and wound healing.

Thermo Scientific UltiMate 3000 HPLC (UHPLC)

The Thermo Scientific Dionex™ UltiMate™ 3000 HPLC (UHPLC) system designed for pressures up to 620 bar (9,000 psi) at flow rates of up to 10 mL/min, detector data collection rates up to 100 Hz, and injection cycle times as low as 15 s. SmartFlow™ and SpinFlow™ ensure optimal flow and gradient performance. Detection versatility is achieved by one sensitive Fluorescence Detector and one low-noise, high-linearity Variable Wavelength Detector. Chromeleon 7 Chromatography software guides user from samples to results.

Waters Gel Permeation Chromatography (GPC)

Waters Gel Permeation Chromatography (GPC) system allows accurate testing of polymer size distributions. The GPC is coupled to an Alliance HPLC system featuring integrated fluidics with a low-dispersion design. Up to four eluents can be automatically conditioned and blended for isocratic, dial-a-mix, AutoBlend, TM or gradient operation. The detection module contains three highly sensitive detection choices including a differential refractive index detector, a UV/Vis detector, and a photodiode array detector. In addition, Waters Informatics and data handling solutions enables efficient, streamlined results management.

2. Biomaterial characterization

Bruker VERTEX 70 Fourier Transform Infrared Spectrometer

Bruker VERTEX 70 FT-IR spectrometer is designed to be versatile for demanding applications in the analytical and research laboratory. All optics are gold coated for high optical throughput. The standard spectral range covers 8,000 to 350cm⁻¹. Range extension packages are available to extend the measurement region from the far- to the near-IR and the visible regions (28,000-15cm⁻¹). Standard resolution is 0.4cm⁻¹ with an option for 0.16cm⁻¹. A scan rate of > 15 spectra/sec at 8cm⁻¹ is standard and can be upgraded to higher rates of 58 spectra/sec at 16cm⁻¹. The Step-Scan technique is also available for kinetic experiments in the μ s and ns range. VERTEX 70 is equipped with wide band spectral range extension VERTEX FM for mid-IR and far-IR. Covers spectral range from 6,000-80cm⁻¹, optionally extendable up to 9,200cm⁻¹, suitable for spectral resolution up to 0.4cm⁻¹, reduced signal to noise ratio at 610cm⁻¹. The Platinum-ATR-accessory, with the robust diamond crystal, enables a fast and reliable FT-IR-analysis of solids and liquids, without sample preparation.

GE Healthcare Biacore T200

GE Healthcare Biacore T200 system offers label-free, versatile assays for studying biomolecular interactions. The system provides precise quantification of kinetic, affinity, concentration, specificity, selectivity, comparability, and thermodynamic interaction data. Wizard templates and customizable methods/evaluation tools are available for both common assays and sample specific applications. The system's extreme high sensitivity enables affinity analysis of the smallest organic compounds, interaction study of rare or sensitive targets, and measurement of kinetic constants over a broad range. Key applications include understanding of molecular mechanisms and structure-function relationships, characterization and assessment of biotherapeutics, optimization of lead compounds during drug discovery, and temporal characterization studies.

JASCO J-1500 Circular Dichroism Spectropolarimeter

In addition to the standard CD, LD, and absorbance scanning, the JASCO J-1500 Circular Dichroism Spectropolarimeter offers up to four simultaneous measurement modes with a wide range of sampling accessories. These accessories enable measurements of a variety of samples, from liquids to films to solid-states. Peltier temperature control system is coupled with six position turreted to run thermal melts, providing researchers with CD and thermodynamic data sets for conformational and folding studies. The extended wavelength range allows measurements to be obtained in both the vacuum-UV and NIR spectral regions using the standard PMT detector (163 – 950 nm).

NanoBrook Omni_Particle Sizer and Zeta Potential Analyzer

The new NanoBrook Omni particle size and zeta potential analyzer provides fast, routine, submicron measurements of size and zeta potential. Most measurements only take a minute or two based on the principles of Dynamic Light Scattering (DLS) for particle sizing and distribution, and on Doppler velocimetry (electrophoretic light scattering, ELS) for zeta potential. The instrument also includes Phase Analysis Light Scattering (PALS) measurements for samples with low mobilities (saline, PBS).

Q800 Dynamic Mechanical Analyzer

A research quality Dynamic Mechanical Analyzer (DMA) that provides viscoelastic measurements on materials from 1000 Pa to 1000 GPa. The temperature and frequency range of operation are -150 to 600 ° C and 0.01 to 200 Hz, respectively. The force range is 0.0001 to 18 Newtons. The amplitude range is 0.5 to 10,000 microns with resolution to 1 nanometer over the entire 25mm of drive shaft travel using a linear optical encoder. The Q800 provides sensitive force measurements down to 0.0001 Newtons, which is ideal for films, fibers and other materials with low stiffness. The module is designed with a full VGA touch control color screen, automated furnace movement, and easy clamping accessibility. The Q800 also includes Advantage (tm) software for complete experimental control of Q Series modules, as well as the Universal Analysis 2000 software package.

TA ARES-G2 Rheometer

To achieve excellent accuracy in viscosity and viscoelastic material characterization, the TA ARES-G2 Rheometer offers decoupled stress and strain measurements free of instrument artifacts over wide ranges of stress, strain, and frequency. The system features separate motor and transducer technology, independent key component control, and intuitive TRIOS software. Normal Force Rebalance Transducer (FRT) module provides wide torque range and normal force range. Brushless DC motor features air bearings for smooth friction free motion, a high-resolution optical encoder for oscillatory angular displacements down to 1 μ rad, and unlimited strain range in steady testing. Motor provides a wide range of angular velocities, and angular frequencies. The TA ARES-G2 is the most advanced rotational rheometer for research and material development.

3. Imaging tools

Bruker SkyScan 1276 X-Ray Microtomograph (micro-CT)

The Bruker SkyScan 1276 desktop X-Ray Microtomograph is designed for fast, *in vivo* scanning of small lab animals and biological samples. The large field of view (up to 80 mm wide and more than 300 mm long) allows full body mouse and rat scanning. High spatial resolution down to 6 μ m voxel size and large image size are achieved by combining continuously variable magnification and 11 Mp X-ray CCD camera (2.8 μ m pixel size). Other features include round and spiral scanning enabled by continuous gantry rotation, low dose imaging allowing longitudinal preclinical studies, and fast GPU-based 3D reconstruction from cross sections.

Delong America LVEM 5 Benchtop Electron Microscope

The Low Voltage Electron Microscope 5 is designed for a broad range of applications in material sciences, such as nanomaterials, polymers and biomaterials, and in life sciences, such as drug discovery and delivery, pathology and virology. The LVEM5 offers a high throughput benchtop solution with nanometer resolutions. The LVEM5 is approximately 90 % smaller than classical electron microscope. There is no need for dark room or cooling water. The LVEM5 provides nanometer level resolution in TEM (Diffraction included), and SEM mode. Low accelerating voltage (5 kV) results in increased electron scattering and enhanced contrast on biological, organic and light materials. A hardware-based enhancement of the TEM imaging mode enables increased total magnification and higher resolving power in the TEM images.

JPK NanoWizard 4a Atomic Force Microscope

The NanoWizard 4a BioScience AFM offers atomic resolution and fast scanning (up to 100Hz) with scan range of 100 μ m. JPK's unique design enables imaging samples in liquids under physiological conditions. With highest mechanical/thermal stability on an inverted microscope and lowest noise level for all AFM components, NanoWizard 4a is optimized for long term experiments even on living cells. The improved QI mode delivers quantitative imaging with the highest resolution for single molecules, live cells or tissues. NanoWizard 4a comes with a wide range of accessories and modes providing full flexibility for any application.

Olympus FLUOVIEW FV3000

The FLUOVIEW FV3000 laser scanning confocal system offers high sensitivity and speed required for 6D (x,y,z,t, λ ,p) live cell and tissue imaging. FV3000 supports complete workflows from live cell imaging through image processing, like deconvolution, and segmentation. The system features a new spectral detection concept for true multichannel spectral imaging with high sensitivity detection in multiple dynamic ranges. The customized 730 nm diode laser and near IR GaAs detector further extends the detection range. With PicoQuant turn-key upgrade kit, time-resolved techniques (e.g. FLIM) can be performed in 2 channels (440 and 485 nm).

Olympus Inverted Fluorescence Microscope IX-83

The Olympus inverted fluorescence microscope IX-83 equipped with ORCA Flash 4.0 sCMOS camera offers high-resolution, high-speed, wide-field digital imaging. The system is fully-motorized and automated. The ZDC module is also available to ensure continuous focus throughout extended time-lapse imaging of live samples.

4. Histology suite

Leica Histology Suite

The Leica Biosystems Suite offers histology and immunohistochemistry. Automated systems are available for tissue processing, embedding, and staining. These include the ASP300 S \square Automated Tissue Processor, HistoCore Arcadia H+C \square Combined Instrument, RM2255 Fully Motorized Microtome, and CM1950 Cryostat.