PVIC Equipment and Services

The Photovoltaic Innovation and Commercialization (PVIC) center offers solar innovators a full spectrum of development services provided by leading vendors in equipment, engineering, testing, failure analysis and certification - as well as other services need to bring PV products to market.

Fabrication Capabilities

- Deposition of semiconductor materials, including:
- Hydrogenated amorphous silicon (a-Si:H)
- Nano crystalline silicon (nc-Si)
- Hydrogenated nano-crystalline silicon (nc-Si:H)
- Polycrystalline silicon (poly-Si)
- Cadmium telluride (CdTe)
- Cadmium sulfide (CdS),
- Copper indium gallium selenide (CIGS)

Deposition of Transparent conductive oxides (TCO)

- Indium tin oxide (ITO)
- Aluminum doped zinc oxide (ZnO:Al)
- Tin Dioxide (SnO2)

Deposition of metallic contacts

- Aluminum (Al)
- Gold (Au)
- Copper (Cu)
- Molybdenum (Mo)
- Titanium (Ti)

Deposition Process

- Plasma chemical vapor deposition
- Physical vapor deposition
- Sputtering
- Dual ion beam deposition
- Spin, dip, and spray deposition of nanoparticles and nanoparticle precursors

Supportive Processes

- Differential Scanning Calorimetry
- Glove-boxes for handling samples in inert atmospheres
- Laser Scribing
- Nanomaterial's synthesis
- Preparation of grid lines – lithography
- Thermal gravimetric analysis
- Thermal processing
- Toxic gases are monitored and instruments are interlocked with fire alarm system for additional safety.

Metrology

Optical Analysis

A PVIC strength is the ability to measure optical properties in real time using Spectroscopic Ellipsometry. In addition to these real-time measurements, the following capabilities are available to measure optical properties:

- Ultraviolet-visible versus Near-infrared (UV-Vis-NIR) optical absorption
- Steady-state and time resolved photoluminescence and spectroscopy
- UV-Vis-NIR spectroscopic Ellipsometry, real time and ex situ modes
- Photoluminescence and I/V surface mapping
- Mid-IR transmission and reflectance spectroscopy and spectroscopic Ellipsometry
- Broadband (UV to mid-IR) transient absorption spectroscopy
- Imaging and Structure Analysis

UT has established several centers devoted to imaging and structure analysis in addition to those located at the PVIC research locations. All of the capabilities listed below are available for use:

- Atomic Force Microscopy
- Raman spectroscopy
- Scanning Confocal Microscopy
- Scanning Electron Microscopy with energy dispersive X-ray spectroscopy
- X-ray diffraction
- Transmission Electron Microscopy
- Depth Profiling Auger Electron Spectroscopy

Solar Panel Testing

PVIC through various funding sources, including NASA, has equipped a robust panel testing facility that is augmented by additional instruments, for testing smaller scale devices and cells, at other UT laboratories. The following is a list of testing equipment available:

- Accelerated life testing at one sun equivalent and elevated temperature
- Cell current, voltage (I/V) and efficiency testing with small area solar simulator
- Environmental and weatherization
- Inert atmosphere quantum efficiency and I/V
- Large area 1.1 m x 1.5 m off-line thin film materials mapping for thickness, index of refraction, and extinction coefficient determination
- Laser beam induced current mapping spectroscopy
- Module-scale current-voltage (I/V) testing with large area solar simulator
- Online thin-film materials mapping designed for glass panel conveyer line
- Voltage breakdown

Fabrication Equipment Pricing

Fabrication Equipment	Equipment Category	***Per hour	Required
Annealing Oven	Sample Treatment	$ **	*
Balances	Sample Prep, Sample Treatment	$ **	
Bath Sonicators	Sample Prep, Sample Treatment	$ **	
Carbon Nanotube Separation	Sample Prep	$ 50	*
CdCl deposition	Sample Post Treatment	$ 50	*
CdTe Linear Sputtering Tool	Deposition	$ 200	*
Centrifuge	Materials Post treat / Sample Prep	$ 50	
Cyclic Voltammetry/Electrochemistry	Deposition	$ 50	
DI/ Ultrasonic/ Glass cleaning	Sample Prep	$ **	
Drying Ovens	Sample Treatment	$ **	
Electron Beam Evaporator	Deposition	$ 80	*
Glove Boxes	Sample Prep, Deposition, Storage	$ 50	*
Glove Boxes (triple w/ ebeam evaporator)	Sample Prep, Deposition, Storage	$ 150	*
Laser Scriber	Sample Post Treatment	$ 170	*
Metal RF/DC Magnetron Sputter	Deposition	$ 170	*
Nanotube Laser Synthesis	Materials Synthesis	$ 170	*
NIMA Dip-Coater	Deposition	$60	*
One dimensional Spray System	Deposition	$ 50	
Photolithography in clean room Photolithography Suss MJB3 Mask Allinger	Pattern Transfer	$ 50	
Plasma Deposition System	Deposition	$ 170	*
Schlenk Line	Materials Synthesis	$ 50	*
Research / Pilot Deposition System with insitu monitoring	Deposition	$ 750	*
Spin coater	Deposition	$ 50	*
TCO RF/DC Magnetron Sputter	Deposition	$ 170	*
Thermal Evaporator (Denton)	Deposition	$ 50	
Two dimensional Spray System	Deposition	$ 50	*
Ultra sonic probe sonicator	Sample Prep	$ 50	*
Ultra-Centrifuge (90K RPM)	Materials Treatment/Sample Prep	$ 80	
Utility Sputter (custom built by Dr. Collins)	Deposition	$ 170	*
Vacuum Filtration	Sample Prep	$ 50	
** Services will require Faculty Collaboration / PVIC supervision of use.* *** Incidental lab instrumentation or equipment included in main process cost* ****Lab entrance fees may be applied in addition to instrumentation and equipment cost*			

Metrology Equipment Pricing

Metrology Services Equipment	Equipment Category	***Per hour	Required
AccuMap Ellipsometer	Materials Characterization	$ 170	*
ARTA (attachment to 1050)	Materials Characterization	$ 170	*
Auger Electron Spectroscopy	Materials Characterization	$ 75	
Cyclic Voltammetry/Electrochemistry	Materials / Device Characterization	$ **	
Dektak 150 Profilometer	Surface/Thickness Characterization	$ 25	
Fourier Transform Infra Red Spectroscopy	Materials Characterization	$ **	
IR-Vase Ellipsometer	Materials Characterization	$ 170	*
IV Solar Simulator	Device Characterization	$ 50	
Lamda 1050 Spectrophotometer	Materials Characterization	$ 80	
Laser Beam Induced Current/Voltage	Device Characterization	$ 170	*
Leak Detector	System Characterization	$ 50	*
Optical Microscope	Surface Characterization	$ **	
Quantum Efficiency	Device Characterization	$ 50	
Raman Spectroscopy/Photoluminescence excitation mapping	Materials Characterization	$ 170	*
Signatone 4-point probe	Electrical Characterization	$ **	
Steady State Photoluminescence	Materials Characterization	$ 50	*
Temperature Programmed Desorption	Materials Characterization	$ 50	
Thermogravimetric analysis	Materials Characterization	$ 50	
Time Resolved Photoluminescence	Materials Characterization	$ 125	*
Ultrafast Laser Spectroscopy	Materials Characterization	$ 200	*
Veeco Atomic Force Microscope	Surface Characterization	$ 80	
V-Vase Ellipsometer	Materials Characterization	$ 170	*
AccuMap Ellipsometer	Materials Characterization	$ 170	*
Solar Simulator Table	Device Characterization	$ 50	

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Solar Testing Services Pricing

Testing Services Equipment	Equipment Category	***Per hour	Required
AccuMap Ellipsometer	Materials Characterization	$ 170	*
Solar Simulator Table	Device Characterization	$ 50	

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