



For easy measurement of
work function and ionization potential

Application Introduction

Model: AC-5



Model: AC-3



Model: AC-2

A New Approach to
Advanced Technology Development
- AC Series Application Introduction -

RIKEN KEIKI Co., Ltd.

AC Series Application Introduction

Contents



Developed by Dr. Masayuki Uda at RIKEN, the Photoemission Yield Spectroscopy in Air (PYSA) is a kind of photoelectron spectrometry which is capable of measuring work function and ionization potential in open air. It can count the number of photoelectrons by using the open counter. It was the world's first analyzer introduced as the AC Series by Riken Keiki, and the manufacture and sale started in 1986.

To help understand the performance of AC series, the application samples of Riken Keiki AC series are introduced in the following contents.

※ The "AC" of the AC Series refers to "air" and "counter" (counting electrons in the air). They are now referred to as open counters after it was subsequently determined that measurement is possible in gases other than the air.



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AC Series Application Introduction

Organic Device (OEL, Organic Solar cells and etc.)

Organic Electro-Luminescence

Material development, device design

A kind of display device using organic materials which illuminate with electricity

Measurement: HOMO level analysis of organic materials, work function analysis of electrode materials.

Advantage: Materials which hold a high conductivity show longer durability and low energy consumption. Thus, it is essential to identify HOMO level so that electric performance of organic materials can be confirmed.



Organic Solar Cells, Dye-sensitive Solar Cell, Perovskite-structured Solar Cell

Material development, device design

A kind of materials which produce electricity when irradiated by solar light.

Measurement: HOMO level analysis of organic materials, metal oxides, perovskite structured compounds, work function analysis of electrode materials.

Advantage: Materials which hold a high conductivity show a high power supply. Thus, it is essential to identify HOMO level so that electric performance of organic materials can be confirmed.



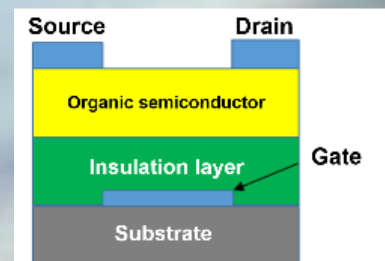
Organic Transistors

Material development, device design

A kind of transistor using organic materials which is made by printer shows a property of low cost and flexibility.

Measurement: HOMO level analysis of organic materials, work function analysis of electrode materials.

Advantage: Materials which hold a high conductivity show longer durability and low energy consumption. Thus, it is essential to identify HOMO level so that electric performance of organic materials can be confirmed.



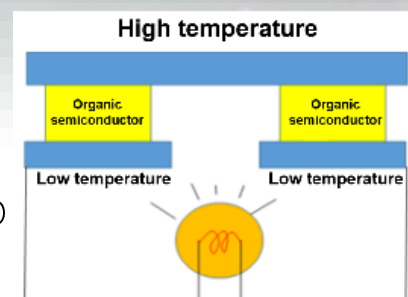
Organic Thermoelectric Conversion Element

Material development, device design

A kind of organic materials can generate power by temperature difference of even hundred °C.

Measurement: HOMO level analysis of organic materials and nanocarbon materials, work function analysis of electrode materials.

Advantage: The principle of power generation is relative with HOMO level so the measurement of HOMO level is very essential.



AC Series Application Introduction

Electrode (Transparent Conductive Film)

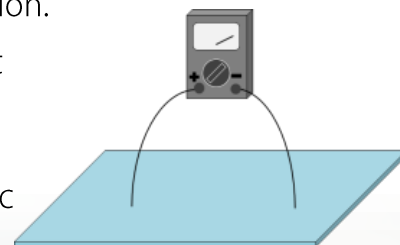
Transparent Conductive Film (ITO)

Material development, device design

Transparent electrode, display, illumination and other various application.

Measurement: Change of the work function during surface treatment corrosion of electrode.

Advantage: Electrode which hold a high conductivity show better performance. Thus, it is essential to identify HOMO level so that electric performance of organic materials can be confirmed.



Metal Electrode

Material development, device design

Electronic device, corrosion protection.

Measurement: Change of the work function during surface treatment corrosion of electrode.

Advantage: Electrode which hold a high conductivity show better performance. Thus, it is essential to identify HOMO level so that electric performance of organic materials can be confirmed.



Novel materials development

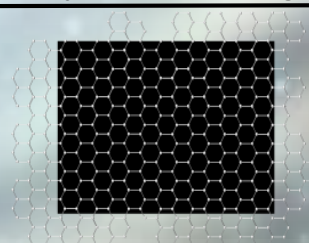
Nanocarbon material, graphene, carbon nanotube, fullerene

Material development, device design

A kind of carbon materials that holds a tube or a football structure.
A novel materials which shows a special electric property or catalytic performance

Measurement: HOMO level of materials.

Advantage: Can be used to develop new application by investigating electron condition.



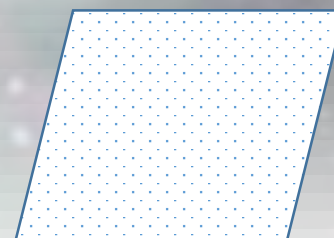
Quantum Dot

Material development, performance evaluation

A kind of material with small sized particles inside, which holds some properties that molecular and powder doesn't, such as photoelectric conversion or luminescence.

Measurement: HOMO level measurement of quantum dot.

Advantage: The special properties of nanoparticles depend on electron condition, which is referred to HOMO level.



Nanoparticles

Material development, performance evaluation

A kind of material with nano-sized particles inside, which holds some properties that molecular and powder doesn't, such as photoelectric conversion or luminescence.

Measurement: HOMO level measurement of nanoparticles

Advantage: HOMO level measurement of nanoparticles



AC Series Application Introduction

Energy (not include solar cells)

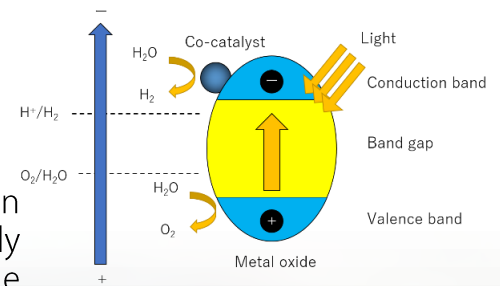
Photocatalysts

Material development, device design

A kind of catalyst which is made of metal oxides can convert water into hydrogen and oxygen by solar light.

Measurement: Electron condition, work function, HOMO level measurement of oxides, nitrides.

Advantage: The decomposition of water occurred by the electron transfer from photocatalyst to water molecular. Thus, it is really important to measure the work function which indicates the difficulty of taking electrons from photocatalysts, which is often in powder form that is hard to be measured under vacuum.



Fuel Cell

Material development, device design

Batteries that generate power from hydrogen and oxygen. It is very important not to use Pt as cathode materials.

Measurement: Electrode HOMO level measurement.

Advantage: Battery performance depends on the work function and HOMO level of the electrode. Especially cathode materials have attract many interests. As the catalyst is often in powder form, it is hard to measure under vacuum.



FCV

Lithium ion battery

Material development, device design

A kind of battery works with lithium ion movement.

Measurement: Electrocatalysts HOMO level measurement.

Advantage: Often used to develop novel electrode materials for high voltage lithium ion batteries.



Silicon Semiconductor Device

Solar cell

Material development, device design

Inorganic solar cells such as silicon, CIGS, which is made by deposition of membrane materials onto silicon wafer surface.

Measurement: The measurement of the dirty on wafer surface or the membrane quality (difference of work function).

Advantage: The dirty on wafer surface may make yield worse. It is important to measure the electron condition for novel device development.



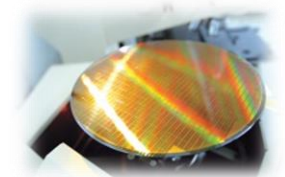
Silicon Device (pre-process)

Material development, device design

Integrated circuit, which is made by membrane deposition onto the silicon wafer surface.

Measurement: The measurement of the dirty on wafer surface or the membrane quality (difference of work function).

Advantage: The dirty on wafer surface may make yield worse. It is important to measure the electron condition for novel device development.



AC Series Application Introduction

Silicon Semiconductor Device

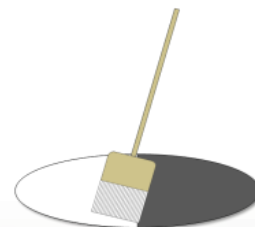
Resist

Material development, device design

Photo resist, which is often used during the manufacture of semiconductor, hardens when irradiated by UV light.

Measurement: The work function measurement of resist and wafer materials.

Advantage: Unnecessary electrons emit from wafer by UV irradiation which may cause hardening of the resist that is not needed to be hardened, so treatments towards wafer is important.



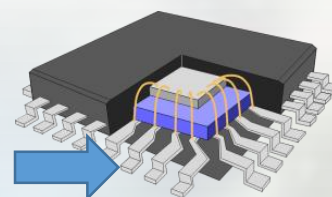
Lead Frame

Material development, device design

Electrode plate for semiconductor device.

Measurement: The oxidation condition and oxide film thickness on the lead frame surface.

Advantage: The lead frame surface oxidation condition or the thickness of oxide film may cause the attachment of chip or wire difficult.



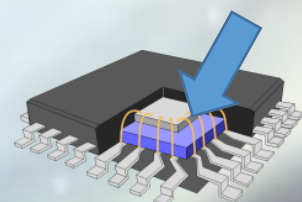
Bonding Wire

Material development, device design

Lead wire inside semiconductor device.

Measurement: The oil film thickness measurement on bonding wires.

Advantage: Bonding wires are bonded through a narrow hole with thin oil coated on the surface to make wires slipping through the hole. The wire cannot slip when the oil film is too thin, and stuck when the film is too thick.



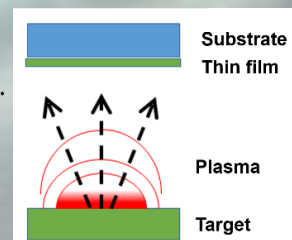
Formation of metal, oxides membranes

Material development, device design

Membrane formed on the substrate.

Measurement: Measurements of work function and HOMO level for thin films.

Advantage: The property of metal or semiconductor film may change even they are made of the same materials. For the quantification of film property is difficult, the work function can be used to analyze the change of the film.



Inorganic Device (not include silicon)

Liquid Crystal Display (LCD)

Material development, device design

A kind of display that made of LCD materials, which change color when a voltage is applied and are pinched by glass with electrode.

Measurement: The HOMO level measurement of LCD materials. The dirty or oxidation condition measurement of electrode surface.

Advantage: The energy consumption of large screen LCD display may increase when there is dirt on the surface. It is important to measure the HOMO level of LCD materials to ensure the decrease of dirt and oxidation.



AC Series Application Introduction

Inorganic Device (not include silicon)

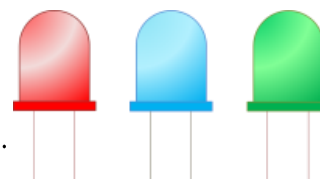
Light Emitting Diode (LED)

Material development, device design

A kind of inorganic materials that illuminate when current flows.

Measurement: The HOMO level measurement of luminescence materials. The work function measurement of electrode materials.

Advantage: The long life of LED materials depend on the current flows. It is important to measure the HOMO level to develop a novel material which makes current flow more easily.



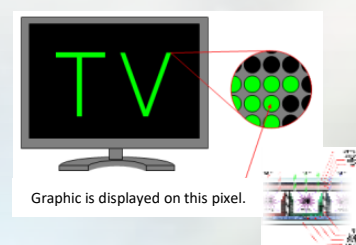
Plasma Display Panel (PDP)

Material development, device design

A display which uses plasma luminescence property.

Measurement: The HOMO level measurement of MgO. The deterioration research of fluorescent substance.

Advantage: It saves more energy when the plasma cell is made of materials (MgO) which holds a lower work function.



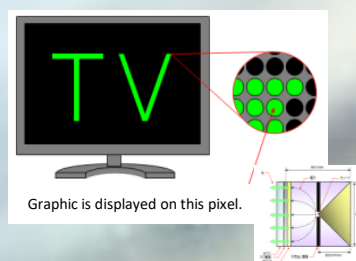
Field Emission Display (FED)

Material development, device design

A kind of display that fluorescent substance illuminates when struck by electrons.

Measurement: The work function measurement of electrode materials.

Advantage: Those materials which hold a lower work function may allow electrons emit more easily.



Charging Device

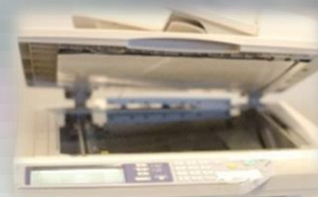
Organic Photo Conductor (OPC)

Material development, device design

Drum cartridge inside the printer.

Measurement: The HOMO level measurement of CGM, CTM

Advantage: Organics are used which allow current flows when irradiated by light. It is important to measure the HOMO level of the materials to confirm the current flow allowance.



Toner

Material development, device design

Powder ink.

Measurement: The work function measurement of toners

Advantage: For the charging amount depends on the work function.



AC Series Application Introduction

Charging Device

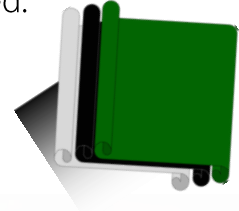
Conductive Rubber

Material development, device design

Charging rollers inside the drum cartridge which is to make the drum charged.

Measurement: The work function measurement of rubbers

Advantage: For the charging amount depends on the work function.



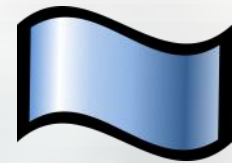
Electronic Paper

Material development, device design

A kind of display made of charging particles which are moved by high voltage.

Measurement: The work function measurement of particles

Advantage: For the charging amount depends on the work function.



Film Thickness Measurement

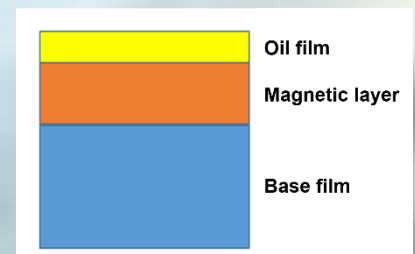
Magnetic Tape

R&D, Process management

Magnetic tapes, used to back-up.

Measurement: The oil thickness measurement on tape surface.

Advantage: The read/write head coated with oil to make it move smoothly. It is important to control the oil film thickness.



Hard Disk Drive(HDD)

R&D, Process management

The center part inside the hard disk drive.

Measurement: The oil thickness measurement on disk surface

Advantage: The read/write head coated with oil to make it move smoothly. It is important to control the oil film thickness.



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