



TECHNICAL SERVICES AND CHARACTERIZATION



NANOTECHNOLOGY & CATALYSIS RESEARCH CENTRE
TECHNICAL SERVICE, SPECTROSCOPY LAB
BLOCK A, LEVEL 2, INSTITUTE OF GRADUATE STUDIES,
UNIVERSITY OF MALAYA, 56000 KUALA LUMPUR, MALAYSIA



**UNIVERSITY
OF MALAYA**



NANOCAT
NANOTECHNOLOGY AND CATALYSIS RESEARCH CENTRE

PREFACE EQUIPMENTS CONTENT

OUR SERVICES

- TESTING & ANALYSIS
- INSTRUMENTATION
- CONSULTATION
- ISO 17025 Accreditation for RAMAN

OUR INSTRUMENTS

SPECTROSCOPY HALL

1. Scanning Electron Microscope (SEM)
2. Raman Spectroscopy (RAMAN)
3. Elemental Analyser (CHNOS)
4. Fourier Transform Infra red (Ex situ-FTIR)
5. Fourier Transform Infra red (In situ-FTIR)
6. Differential Scanning Calorimetry (DSC)
7. Differential Scanning Calorimetry (In situ-DSC)
8. Zeta Potential (ZP)
9. Particle Size Distribution (PSD)
10. Thermogravimetry Analysis (TGA)
11. Thermogravimetry Mass Spectroscopy (TG-MS)
12. UV-Vis Spectroscopy (UV-VIS)
13. Vibration Sample Magnometer (VSM)
14. Hall Effect
 - Ball milling

X-RAY HALL

15. X-Ray Fluorescence (XRF)
16. X-Ray Diffraction (Ex situ-XRD)
17. X-Ray Diffraction (In situ-XRD)

REACTOR HALL

18. Karl Fischer Coulometer (KF)
19. Freeze Dryer
20. Autoclave 200 ml HS/SS
21. Density Meter
22. Selective Oxidation Fixed-bed Reactor (SELOX)
23. Precipitation Reactor (Lab Max)
24. Trickle Flow Reactor (TFR)
 - Microwave

COMBINATORIAL HALL

25. High Performance Liquid Chromatography (HPLC)
26. Gas Chromatography (TCD-FID)
27. Gas Chromatography (GC-MS)
28. Temperature Programmed Desorption, Reduction, and Oxidation (TPDRO)
29. Surface Area Analyser (BET Single Port)
30. Tensiometer (Surface Tension)
31. Fixed-bed Microreactor (atmospheric pressure).
32. Gel Permeation Chromatography (GPC)
33. Ion Chromatography (IC)

SCANNING ELECTRON MICROSCOPE (SEM)

SPECIFICATION

- High vacuum
- Model: FEI Quanta 200 FESEM
- Deliverable: Maximum 3 images per hour

- Low vacuum
- Model: FEI Quanta 200 FESEM
- Deliverable: Maximum 3 images per hour
- Software: Microscope XT
- Sample: 1g solid only

ANALYSIS

- Microstructure analysis
- Composition analysis
- Elemental mapping



RAMAN SPECTROSCOPY (RAMAN)

SPECIFICATION

- Brand : Renishaw
- Model : In Via Raman Microscope
- Type of laser :
 - (1) UV
 - (2) Vis
 - (3) NIR
- Software: Wire
- Sample: 0.1 g Solid/Liquid
- NOTE: per sample/per laser
- **ISO 17025 Accreditation**

ANALYSIS

- Material identification and analysis
- Phase identification of material.



ELEMENTAL ANALYZER (CHNOS)

SPECIFICATION

- Brand : Leco
- The unique design and detection scheme of the TruSpec Micro utilizes a combination of flow-through carrier gas and individual, highly selective infrared (IR) and thermal conductivity detectors resulting in simultaneous determination of CHNS in less than four minutes.

- The TruSpec Micro Oxygen Module utilizes an independent high-temperature (1300 °C) pyrolysis system providing an oxygen result in two minutes.

ANALYSIS

- Software: TruSpec
- Sample: 1-15 mg organic only
- Note:
 - Max temperature CHNS: 1100 °C,
 - Max temperature O: 1300 °C,
 - Analysis time: 5 min



FOURIER TRANSFORM **INFRA RED** (EX SITU-FTIR)

SPECIFICATION

- Model: IFS66v/S
- Accessories: ATR, DRIFTS, HTHP
- Software: Bruker Optic GmBH
19972000 OPUS Version 3.1
- Sample: 1 g Liquid, Solid



ANALYSIS

- Determination isomers.
- Characterization of wax, resin, polymer and emulsifier.
- Identified the energy level in semiconductors.
- Identified the functional group in an organic molecule.
- Determine the mechanism of heterogeneous catalysis.

FOURIER TRANSFORM **INFRA RED** (IN SITU-FTIR)

SPECIFICATION

- Model: IFS66v/S
- Accessories: DLATGS Detector
- Condition: In vacuum
- Mixture gas (mass flow controller)
- Heating (variable temp.)
- Software: Bruker Optic GmbH 19972000 OPUS Version 3.1
- Sample: 1 g liquid, solid

ANALYSIS

- Determination isomers.
- Characterization of wax, resin, polymer and emulsifier
- Identified the energy level in semiconductors
- Identified the functional group in an organic molecule.
- Determine the mechanism of heterogeneous catalysis



DIFFERENTIAL SCANNING CALORIMETRY (DSC)

SPECIFICATION

- Brand : Mettler Toledo
- Model : DSC 822e
- Software: Star e



ANALYSIS

- Phase identification of Detect the physical or chemical changes in a material that are accompanied by adsorption (endothermic) or liberation of heat (exothermic).

DIFFERENTIAL **SCANNING** CALORIMETRY (IN SITU-DSC)

SPECIFICATION

- Brand : Mettler Toledo
- Model : HP DSC 827e
- Software: Star e Quadstar
- Sample: Solid, liquid

ANALYSIS

- Monitor sample behavior in close condition with mixture gas.
- Attached with MS to analysis ion current that evolve during analysis.
- Quantify the thermal events, if the original mass of sample is known.



ZETA POTENTIAL (ZP)

- Model: Zetasizer Nanoseries by Malvern Technique : Laser Light Diffraction
- Particle size measured from 5nm to 10 micrometer

SPECIFICATION

- Deliverable: Zeta potential , electrophoretic Mobility
- Software: Zetasizer
- Sample: 10 ml (Liquid)
- NOTE: Price is different with out own cuvette



ANALYSIS

- Measure zeta potential of particles



PARTICLE SIZE DISTRIBUTION (PSD)

SPECIFICATION

- Model: Malvern
- Software: Zetasizer
- Sample:
Min 30 ml (Liquid)

ANALYSIS

- To measure particle size distribution of the sample.



THERMOGRAVIMETRY ANALYSIS (TGA)

SPECIFICATION

- Brand : Mettler Toledo TGA/SDTA 851e
- Model : TGA/SDTA 851e
- Software: Star E



ANALYSIS

- Thermal and oxidative decomposition processes
- Evaporative and sublimation processes
- Identification of solvents or additives
- Adsorption and desorption behavior

THERMOGRAVIMETRY **MASS** SPECTROSCOPY (TG-MS)

SPECIFICATION

- Brand : Mettler Toledo TGA/SDTA 851e
- Model : TGA/SDTA 851e
- Software: Star E Quadstar MS

- Sample:
Min 1 g (Solid)
Min 30 ml (Liquid)

ANALYSIS

- Thermal and oxidative decomposition processes
- Evaporative and sublimation processes
- Identification of solvents or additives
- Adsorption and desorption behavior



UV VIS SPECTROSCOPY (UV-VIS)

SPECIFICATION

- Model: UV/ Vis Perkin Elmer Lambda 35
- Wavelength range: 190-1100 nm
- Variables slits: (0.5,1,2 and 4) nm
- Ordinate mode:
 - - FR (Kubelka Munk)
 - - % R (Reflectance)
 - - % T (Transmittance)
 - - A (Absorbance)



- Deliverable: UV-Vis spectrum
- Model: Malvern
- Brand : Lake Shore
- Model : 7400 Series VSM System /EM7 HV Electromagnet
- Amount of sample : 0.1 g
- Software: UV WinlabTM

ANALYSIS

- Surface Characterization
- Color measurement
- Thermochromism
- Composition of opaque,
- Biological & geological specimens.
- Photometric analysis.
- Translucent transparent and turbid samples

VIBRATION **SAMPLE** MAGNOMETER (VSM)

SPECIFICATION

- Model: Lake Shore 7400 Series VSM system
- Experiment Type:
 - i. Hysteresis (H_{max} - H_{max} - H_{max})
 - ii. Initial curve only (0 - max)
 - iii. Both (0 - H_{max} - H_{max} - H_{max})
- Field: Maximum 8000 Oe
- Software: Lake Shore VSM version 4.6.0
- Sample: Solid, liquid, and film.

ANALYSIS

- Characterize the DC magnetic properties of materials as a function of magnetic field, temperature, and time.



HALL EFFECT

SPECIFICATION

- Brand : Lake Shore
- Model : 7400 Series VSM System / EM7 HV Electromagnet
- Software: Hall effect
- Sample: 0.1 g



ANALYSIS

- Characterize the DC magnetic properties of materials as a function of magnetic field, temperature, and time.

X-RAY FLUORESCENCE (XRF)

SPECIFICATION

- Brand: Bruker
- Model: S4 Explorer X-Ray Fluorescence
- Elemental analysis:
 - a) Be to U (solid sample)
 - b) Na to U (all samples)
- Software: Spectra plus V.164
- Sample: Min 1 g powder and liquid.

ANALYSIS

- Elemental and oxides composition.

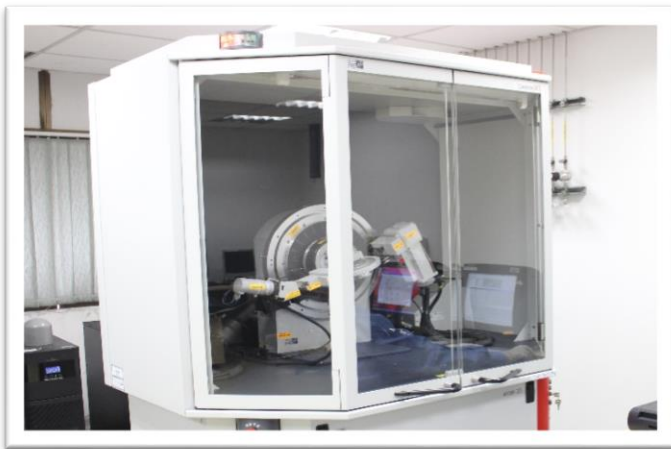


X-RAY DIFFRACTION (EX SITU-XRD)

- Brand: Bruker
- Model: D8 Advance X-Ray Diffractometer
- Software: DIFFRAC plus-EVA
ICDD Powder Diffraction File Database

SPECIFICATION

- Sample: Solid, powder & thin film only (min 1 g)



ANALYSIS

- Phase and compositional identification

X-RAY DIFFRACTION (IN SITU-XRD)

SPECIFICATION

- Brand: Bruker
- Model: D8 Advance X-Ray Diffractometer
- Equipped with XRK 900 heating chamber (up to 900 °C) and Mass Flow Controller (3panels)
- Gas evolution analysis by Gas

- Chromatography (GC) & Mass Spectrometer (MS)
- Software: DIFFRAC plus-EVA
ICDD Powder Diffraction File Database
- Sample: 3 g powder only
- NOTE: Price is different with additional scan/ with MS result

ANALYSIS

- Phase transition analysis with temperature and gas flow.



KARL FISCHER COULOMETER (KF)

SPECIFICATION

- Brand: Metrohm
- Model: 860 KF Thermoprep
- Equipped with Needle Holder 73mm Luer-Lock

- Temperature Range: 50°C-250°C
- Heating Rate: 15°C/min
- Gas Flow: 10 - 150 mL/min



ANALYSIS

- Karl Fischer titration, being efficient, rapid and accurate, is the most important method for determining water contents

FREEZE DRYER

SPECIFICATION

- Brand: LabConco
- Model: FreeZone 4.5
- Collector Temperature: -50 °C, -58 °F

- Ice Holding Capacity: 4.5L
- Built-in 10-port Drying Chamber

ANALYSIS

- Designed for light aqueous sample loads
- Not for use with samples containing acetonitrile
- Removes a maximum of over 2 liters of water in 24 hours



AUTOCLAVE 200 ML HS/SS

SPECIFICATION

- Reactor Capacity: 200 mL
- Max. Oper. Pressure: 300 bar
- Max. Oper. Temperature: 250 °C
- Body: Hastelloy/ Stainless steel
- Software: Topview



ANALYSIS

- Hydrogenation
- Oxidation
- Esterification
- Hydrothermal



DENSITY METER

SPECIFICATION

- Brand: Anton Paar GmbH
- Model: DMA 4100M
- Average Temperature: 22.0 +/- 1°C

ANALYSIS

- Device that measures the density.



SELECTIVE OXIDATION **FIXED-BED** REACTOR (SELOX)

SPECIFICATION

- Reactor Capacity: 35mL
- Catalyst Capacity: 10mL
- Max. Oper. Pressure: 100 bar
- Max. Oper. Temperature: 500 °C
- Attach with GC (TCD-FID)
- Software: Wonderware



ANALYSIS

- Methanol Synthesis
- Methanol Reforming
- CO Oxidation

PRECIPITATION REACTOR (LAB MAX)

SPECIFICATION

- Brand: Mettler Toledo
- Model: LabMax
- Equipped with pH probe, turbidity and conductivity probe.
- Capacity: 2000 mL.
- Sol-Gel, Co-precipitation Synthesis.
- Software: WinRC_LM7.3

ANALYSIS

- Sol-Gel.
- Co- precipitation.
- Synthesis.

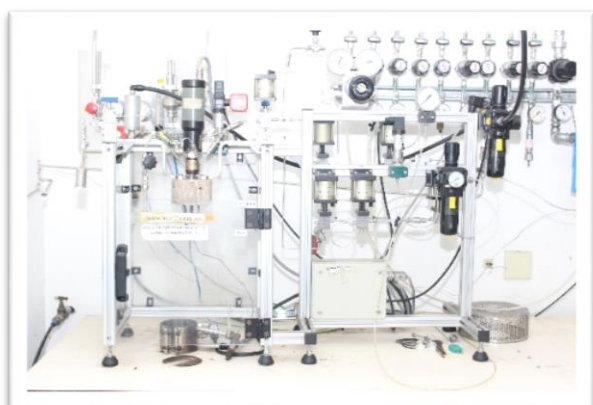


TRICKLE FLOW REACTOR (TFR)

- Reactor Capacity: 200mL
- Catalyst Capacity: 100mL
- Max. Oper. Pressure: 300 bar @ 350°C
- Max. Oper. Temperature: 450°C @ 50bar

SPECIFICATION

- Separator Capacity: 1L
- Attach with GC (TCD-FID)
- Software: Wonderware



ANALYSIS

- Ammoxidation
- Methanol Synthesis
- Dehydrosulphurization
- Gas to Liquid (Fischer-Tropsch)

HIGH PERFORMANCE LIQUID CHROMATOGRAPHY (HPLC)

SPECIFICATION

- Agilent technologies, 1100 series.

ANALYSIS

- To separate, and identify compounds that are present in any sample that can be dissolved in a liquid in trace concentrations as low as parts per trillion.



GAS CHROMATOGRAPHY (TCD-FID)

SPECIFICATION

- 6890 Agilent Technologies
- Thermal conductivity detector & flame ionization detector
- Split/splitless inlet
- Online injection or manual injection
- Software: Chemstation



ANALYSIS

- To analyze permanent gases (Argon, Nitrogen, Hydrogen, Carbon Dioxide, etc) and light hydrocarbon
- To separate compound contain organic / heavy hydrocarbon

GAS CHROMATOGRAPHY (GC-MS)

SPECIFICATION

- 5973 Agilent Technologies.
- Mass spectroscopy detector with auto sampler.
- Software: Chemstation

ANALYSIS

- Primarily restricted to volatile and semi-volatile compounds
- Identifying and quantifying volatile organic compounds in mixtures



TEMPERATURE PROGRAMMED DESORPTION, REDUCTION, AND OXIDATION (TPDRO)

SPECIFICATION

- Brand: Thermo Finnigan
- Model: TPDRO 1100
- Two independent and interchangeable sample positions (ovens) for catalyst activation (pretreatment) and analysis
- Temperature range: RT to 750°C
- Types of carrier gas: H₂, O₂, CO₂, NOX, N₂, He, Ar, Air.
- Pressure: 100kPa
- Flowrate: 10 - 200ml/min (H₂)
- Software: TPD/R/O 1100 (Ver2.3)



ANALYSIS

- Temperature of desorption / reduction or oxidation

SURFACE AREA ANALYSER (BET SINGLE PORT)

SPECIFICATION

- Sorptometric 1990 series.

ANALYSIS

- To measure the specific surface area of materials.



TENSIOMETER (SURFACE TENSION)

SPECIFICATION

- Brand: Dataphysic
- Model: DCAT series



ANALYSIS

- Surface and interfacial tension

FIXED-BED MICROREACTOR (ATMOSPHERIC PRESSURE)

SPECIFICATION

- Brand: CRD
- Highthroughput System Nanoflow
- 12 parallel continuous flow reactor
- Pressure rating: atmospheric
- Temperature rating: 600 °C
- Attach with 2 online GC
- Software: Wonderware

ANALYSIS

- To analyse permanent
- For catalyst screening purpose.
- To see catalyst performance.
- Hydrogenation process
- Selective oxidation of propane to acrylic acid
- Oxydehydrogenation of propane to propylene.
- Methanation process



GEL PERMEATION CHROMATOGRAPHY (GPC)

SPECIFICATION

- Viscotek GPC Max 2001
- Packing material: Modified porous styrene divinylbenzene copolymer
- Max P: 3.5MPa per column
- Max Flowrate: (analysis) 2.0ml/min, (solvent exchange) 0.5ml/min
- Temperature: up to 70°C



ANALYSIS

- To determine the relative molecular weight of polymer samples.

ION CHROMATOGRAPHY (IC)

SPECIFICATION

- Brand: Metrohm
- Model: 882 COMPACT IC PLUS
- Software: MagicNet 2.3

ANALYSIS

- Colloidal anions concentration



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