

# ANNUAL REPORT 2019

This annual report is a comprehensive report of Nanotechnology & Catalysis Research Centre (NANOCAT) activities throughout the year 2019. It is intended to give information about the NANOCAT activities, publications, grants, latest achievements, awardings and many more.



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This report outlines the performance of the centre for research in nanotechnology and catalysis over the calendar year 2019. The report concentrates on the centre's financial and academic performance, and describes the centre's strategy for growth. All the data included was acquired over the period January 1<sup>st</sup> 2019 to January 1<sup>st</sup> 2020. The amount of grant (RM) listed was based on calendar year of 2019 from both new and ongoing projects.

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1<sup>st</sup> March 2020

## DIRECTOR'S STATEMENT

Nanotechnology and Catalysis Research Center (NANOCAT) has been established since 2001 at University of Malaya as a specialized centre of excellence (COE) in nanotechnology and catalysis. Our vision is to be an internationally renowned and recognised CoE in Catalysis and Nanomaterials . NANOCAT offers students, researchers and academics a wonderful place to study and research. It is highly interdisciplinary in that chemists, biologists, physicists and engineers all work together to create amazing new materials with remarkable properties and to develop devices that change the way we live. They are also encouraged to carry out their individual scientific research resulting in publications in the best journals. NANOCAT also has strong collaboration with the industrial partner such as Petronas, Hartalega, Oleon and others. We have access to the latest analytical equipment including field emission scanning electron microscopes, x-ray diffraction, BET analysis, various spectroscopies, chemical reactors and thermal analysis methods.



**Prof. Dr. Mohd Rafie Bin Johan**

Director of Nanotechnology & Catalysis Research Centre (NANOCAT).



ORCID URL

### ***Mission***

*To advance technological excellence in multidisciplinary research to address the key challenges of 21st century.*

### ***Vision***

*To be an internationally renowned and recognised CoE in Catalysis and Nanomaterials*

## About NANOCAT

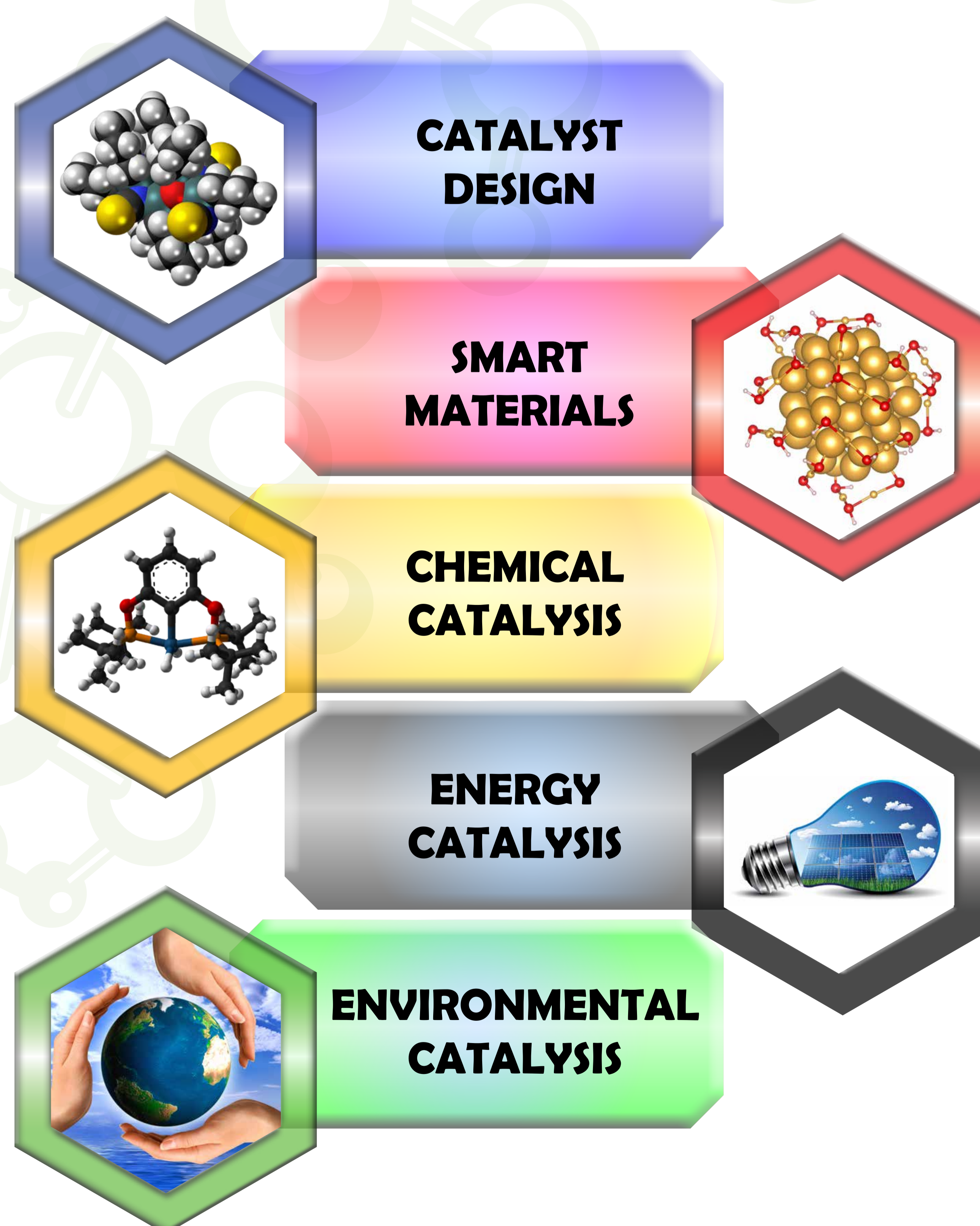
NANOCAT (Nanotechnology and Catalysis Research centre) is a pTJ incorporated by UM in 2012, a UMCoE. Its mission is to be a world leader in “catalysis and nanotechnology” coining sustainability and green technology. NANOCAT research thrust is deploying catalysis to support energy, chemical synthesis, environment pollution and global warming mitigation as well as designing smart materials as catalyst, sensor, nanocoating, and nanocomposite.

NANOCAT was given a status of HiCoE Potential in 2013, in catalysis. The Centre has strived to attain a national status for HiCOE (MOHE) as well as NanoCentre (NNC, MOSTI) with strong support and commitment from Universiti Malaya. In the last 3 years, 2016 to 2019, it witnessed a pronounced explosion in its productivity in all aspects.

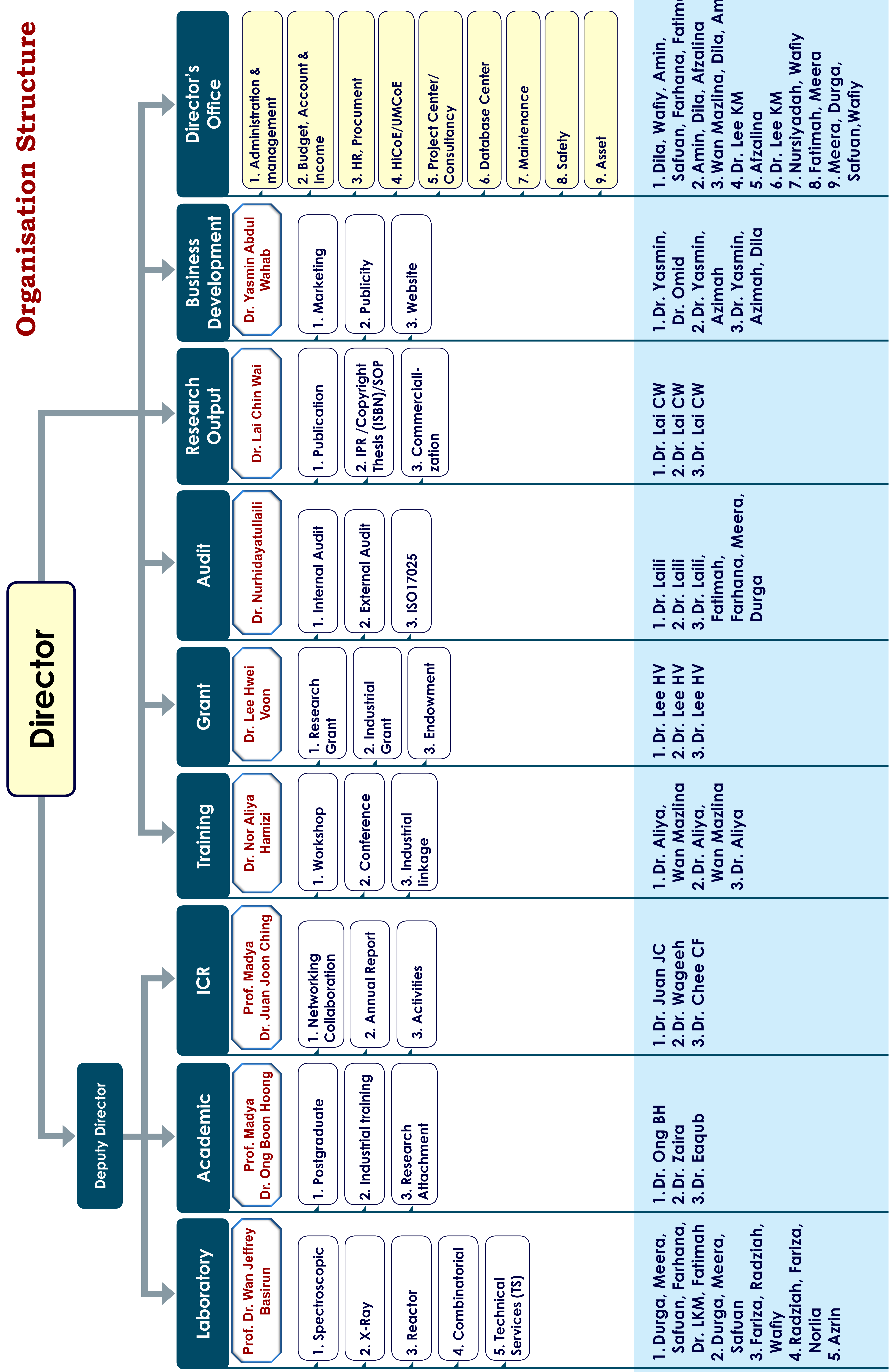
### Research Projects

As a national research centre focusing on nanotechnology and catalysis, NANOCAT has come out with a strategic planning in research grant application. With that in mind, the emphasis has been given to five niche areas of NANOCAT which are catalyst design, energy, chemical synthesis, and environmental mitigation as well as smart materials.

### Scope of Research



# Organisation Structure



## NANOCAT Management



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### **Prof. Dr. Mohd Rafie Bin Johan**

Director of Nanotechnology & Catalysis Research Centre (NANOCAT)

Mohd Rafie Johan was a Professor of Materials Engineering in Department of Mechanical Engineering, University of Malaya. Currently, he is Director of Nanotechnology and Catalysis Research Center (NANOCAT), University of Malaya. He gained his PhD in 2005 from Department of Physics, University of Malaya. He is the author in 170 peer-reviewed (ISI) papers with H-index 21. Prof. Rafie is well recognized internationally in the field of Nanotechnology. Testimony to this, he has been elected in Evaluation Panels for AET and ITR clusters and UPGP and for grants applications at UMRG, PRGS, FRGS and Qatar Foundation. He has been appointed as a panel for Yang di Pertuan Agong Scholarship and COMSTECs for Islamic Organization Country for evaluation of best scientific papers for Muslim Scientist. He also secured funding as PI from the University of Malaya and Malaysian Government. For the past two years, Prof Rafie has been appointed the editor-in-chief of The International Conference of Science and Engineering Materials (ICOSEM). Prof Rafie has been invited as a speaker to numerous talks and conferences and also Guest Editor for Symmetry (ISI journal) and editor for Asean Engineering Journal. He leads Nanomaterials Engineering Research Group of 15 PhD and 22 Master. These supervised students span over a quite broad scientific area going from science (chemistry, physics, material science, biology) to engineering (chemical, material).



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### **Prof. Dr. Wan Jeffrey Basirun**

Deputy Director of Nanotechnology & Catalysis Research Centre (NANOCAT)

Wan Jeffrey Basirun is currently a Professor in Electrochemistry and Physical Chemistry started his career in the department of Chemistry, University Malaya as the department undergraduate tutor in 1991 upon graduation in bachelors in Science with honors majoring in Chemistry, and proceeded with a PhD degree in electrochemistry in 1997 from the University of Southampton in United Kingdom in 1997. Since joining the active research groups in the department of Chemistry in 1997, he has supervised a total of 17 PhD and 7 Master students to completion, in addition have authored and co-authored more than 200 papers in journals indexed ISI web of knowledge, with a H-Index of 26. His appointment as the Deputy Director in Nanocat in July 2018 is aimed to strengthen NanoCat's niche research areas. His research interest is on the use of nanomaterials and nanocomposites in catalytic processes, sensors, biomaterials and energy conversion and storage.

## NANOCAT Academic Staffs



### Assoc. Prof. Dr. Ong Boon Hoong

Dr. Ong is an associate professor at NANOCAT since 2014. Prior to the appointment at UM, he has been served 10 years at the Faculty of Engineering, Multimedia University, Malaysia. Dr. Ong received both his B.Sc.(Hons) and Ph.D in Materials Science from the National University of Malaysia. He and his team are currently working on the synthesis and design of advanced functional nanomaterials, particularly semiconductor and magnetic nanostructures, and explore their potential applications in environment, energy, nanoelectronics and biomedicine.



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### Assoc. Prof. Dr. Juan Joon Ching, NANOCAT

Dr. Juan Joon Ching is an Associate Professor at NANOCAT, University of Malaysia and also has been appointed as a Senior Research Fellow (Adjunct) at Monash University, Malaysia. He received his PhD in Chemistry (2007) and BSc (Hons) Chemical Technology (2003) from National University of Malaysia. Most of his research activities are mainly focused on nanomaterial and catalyst to be applied in energy and environment sectors. Besides that, he also involved in green technology such as biomass utilization, biolubricant, hydrogen generation, and value added product from micro/macro algae.



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### Assoc. Prof. Dr. Yarub Al-Douri

Yarub Al-Douri has gained Doctorat D'état in Materials Science (2000). He was appointed Full-Professor, Visiting Professor, Adjunct Professor, Consultant Expert, Associate Professor, Assistant Professor, Research Fellow (A), Scientific Collaborator and Post-doc in Malaysia, Iraq, Turkey, Algeria, Yemen, Singapore, Germany and France, respectively. Al-Douri has initiated Nanotechnology Engineering MSc Program and Nano Computing Laboratory, the first in Malaysia. He has received numerous accolades including JSPS Award 2019, AUA Award 2019, IFIA Award 2019, Gold Award at ITEX KL 2013, TWAS-UNESCO 2009 & 2012.



### Ir. Dr. Lai Chin Wei

Ir. Dr. Lai Chin Wei is a senior lecturer in the Nanotechnology & Catalysis Research Centre, University of Malaya. Lai's main research interests are in the areas of chemically modified metal oxide photocatalysts and graphene materials, mainly applied in environmental pollution management and solar energy technology. Lai has spent almost 5 years to develop, optimize and simplify the technology lies in the synthesis of nanoparticles, metal oxide nano-architecture and carbon/graphene materials which are of high significance for green energy and environment applications.



### Dr. Nurhidayatullaili Binti Muhd Julkapli

Dr. Nurhidayatullaili Muhd Julkapli is one of academic staff at NANOCAT Research Center, UM from year of 2013. She has obtained her PhD in Biopolymer (Polymer Engineering) from Universiti Sains Malaya on 2012. Her research area are in biocomposites, biopolymer, nanotechnology and photocatalysis. Currently she managed to published more than 30 ISI paper and attending several numbers of national and international conferences. She has been appointed as Deputy Director of NANOCAT Research Center since 2014. As a deputy director she is responsible to monitor, manage and plan on the research areas, research grants, human resources (non academic), budget and auditing activities of NANOCAT Research Center.



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### Dr. Lee Hwei Voon

Dr. Lee is a senior lecturer in the Nanotechnology and catalysis research center, University of Malaya, Malaysia. She has received her PhD in Catalysis (2013) and BSc (Hons) in Industrial Chemistry (2008) from Universiti Putra Malaysia. Her major research interest are Energy & Fuels (Biodiesel, Renewable Diesel, Biofuels); Biomass Conversion Technology (Catalytic conversion of biomass); Oleochemical Technology (Methyl ester, Polyol ester), Catalysis (Heterogeneous catalyst, mixed metal oxides, acid-base catalyst) and Nano-Materials (Nanocrystalline cellulose).



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## NANOCAT Academic Staffs



### Dr. Wageeh Abdulhadi

Dr. Wageeh is a senior lecturer in the Nanotechnology and catalysis research center, University of Malaya, Malaysia. He was awarded a BSs (Hons), MSc in Organic Chemistry (1995) from the University of Mosul, PhD in Organic Synthesis (2012) from University of Malaya. His major research interest areas include organic synthesis and synthetic methodology, catalysis of organic reactions, in silico design and synthesis, functionalization of nanoparticles, nanocellulose and nanoantioxidant.



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### Dr. Chee Chin Fei

Dr. Chee is a senior lecturer at Nanocat since 2016. He graduated from the University of Malaya with M.Phil. and PhD degrees. He was a senior scientist at Aurigene Discovery Technologies prior to joining UM. His research interests include organic and synthetic chemistry, natural products, food chemistry, biomaterials, drug design and development.

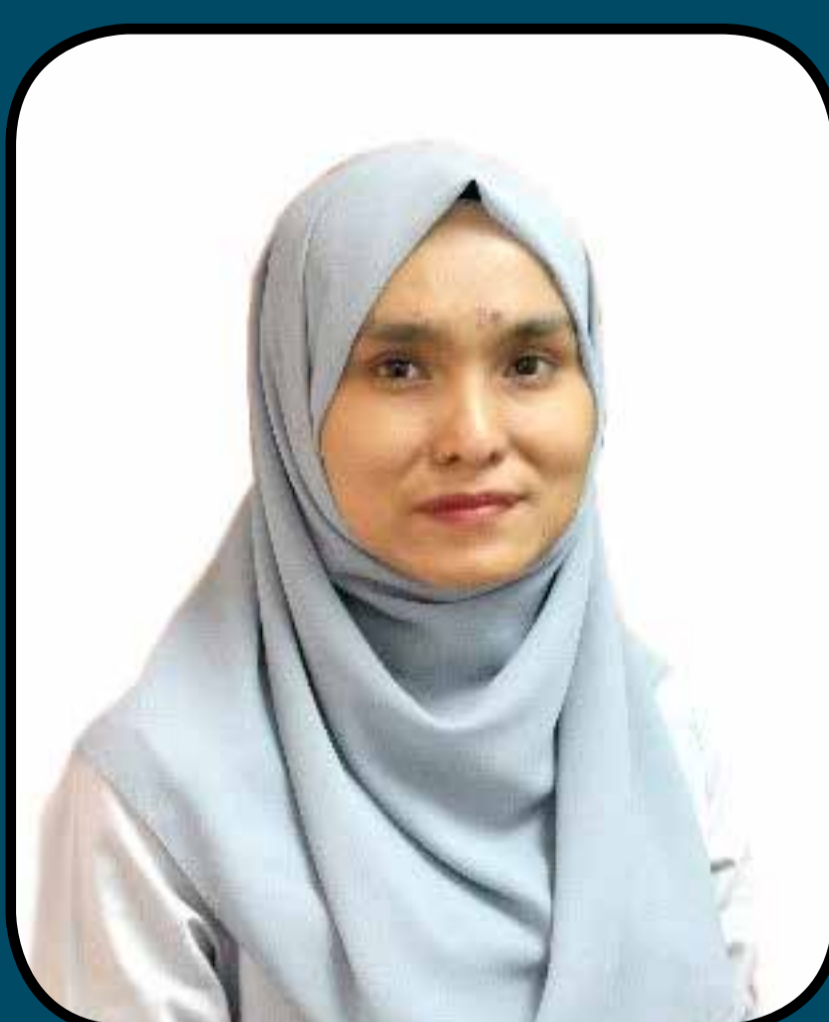


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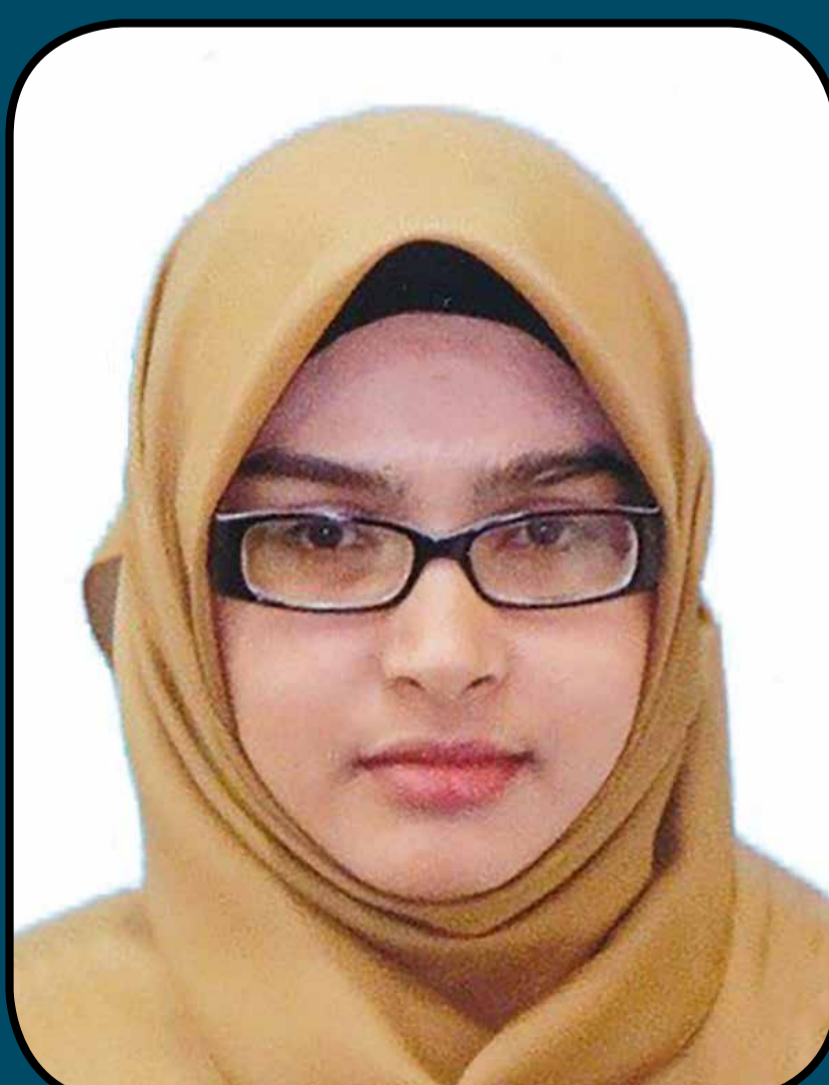
### Dr. Zaira Zaman Chowdhury

Dr. Zaira Zaman Chowdhury is presently appointed as Senior Lecturer & Industrial Training Coordinator in Nanotechnology & Catalysis Research Centre (NANOCAT) in University Malaya. Previously she was working as a Senior Research Fellow in under the same Research Centre (NANOCAT). She received her PhD in Environmental Analytical Chemistry from University of Malaya in 2013, whilst MSc. in 2003, and BSc. in Applied Chemistry and Chemical Engineering Technology from University of Dhaka, Bangladesh in 2001. She has experience in development of fiber polymer composites, waste water treatment and adsorbent preparation for batch and fixed bed adsorption system. She has worked for synthesis of micro and nano structured carbon and biomass processing using catalyst. She has conducted some research to illustrate the catalytic application of carbon as well as extraction of nano and micro dimensional cellulose.



### Dr. Nor Aliya Hamizi

Dr. Nor Aliya Hamizi is a Senior Lecturer at Nanotechnology and Catalysis Research Centre (NANOCAT), UM and currently is a head of training unit for NANOCAT. Prior to this, she had served as senior lecturer at University Kuala Lumpur (MIMET). She obtained her PhD at Faculty of Engineering, UM in 2017, Master of Engineering Science (Nanotechnology) at UM in 2011 and her BEng (Materials Engineering) at UM in 2008. Her current areas of expertise include nanotechnology, quantum dots, chemical synthesis and optical characterizations.



### Dr. Yasmin Abdul Wahab

Dr. Yasmin Abdul Wahab is a senior lecturer in Nanotechnology & Catalysis Research Centre in University of Malaya. She received her PhD in Microelectronics (Electronics Engineering) from University of Malaya in 2015. Prior to joining NANOCAT, she spent 12 years in SilTerra Malaysia and Monash University where she was part of back-end operation project team and teaching. She led research on various cost and cycle time reduction, productivity improvement projects in BEOL processing in semiconductor foundry. Her research interest includes semiconductor materials, processes and fabrication technology, reliability physics of devices, flexible electronics and nanobiosensors.



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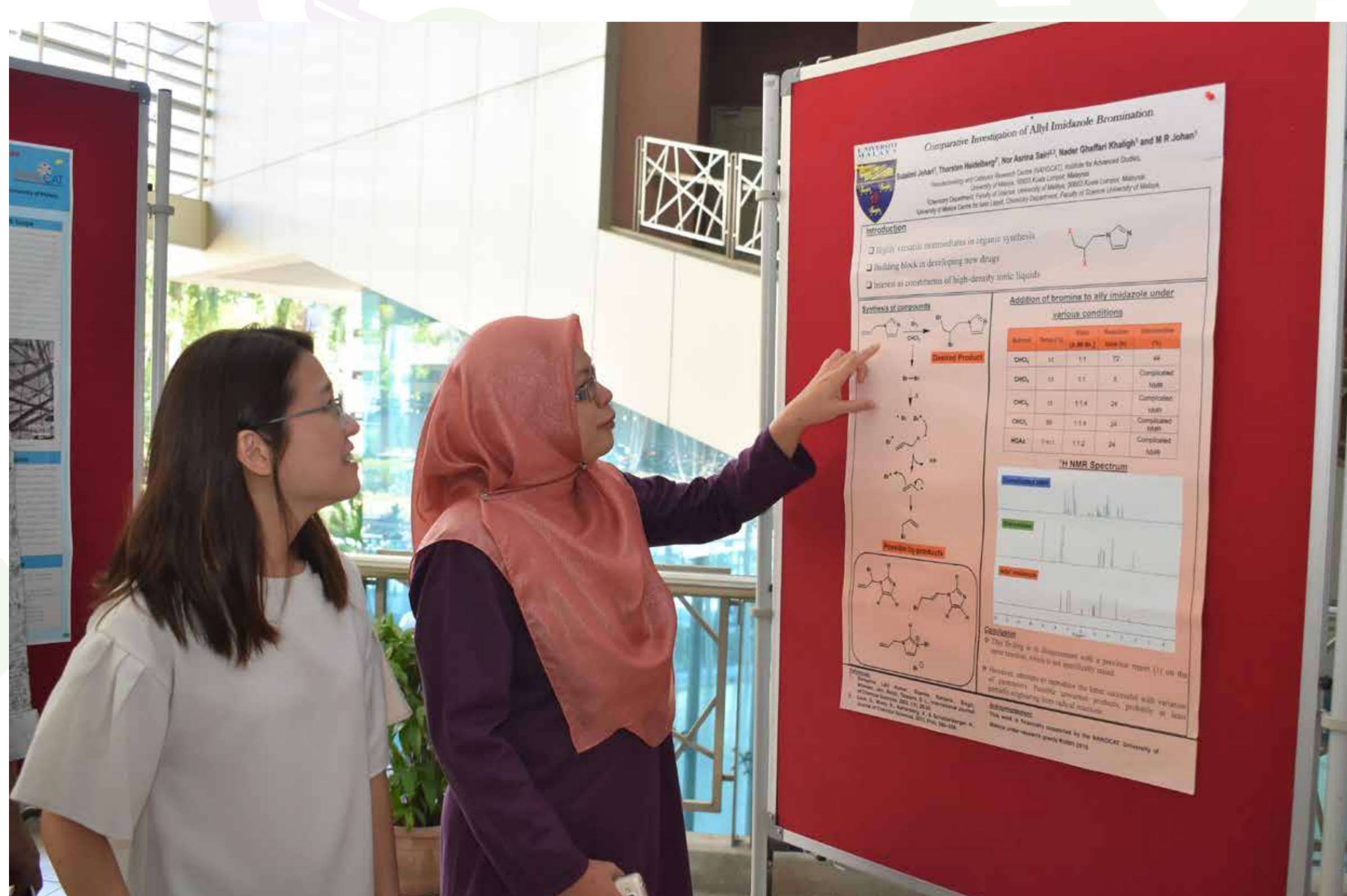


## Inaugural Lecture

Year 2019 has been a proud year for NANOCAT family since our Director, Prof. Dr. Mohd Rafie Johan has delivered a distinguished Inaugural Lecture on “Quantum Physics, Nanotechnology and Philosophy: An exploration to the inner dimension of life and the destiny of man”. It was held on 5th December 2019 from 11 am to 12.30 pm at Auditorium of Research Management & Innovation Complex with more than 200 audiences.



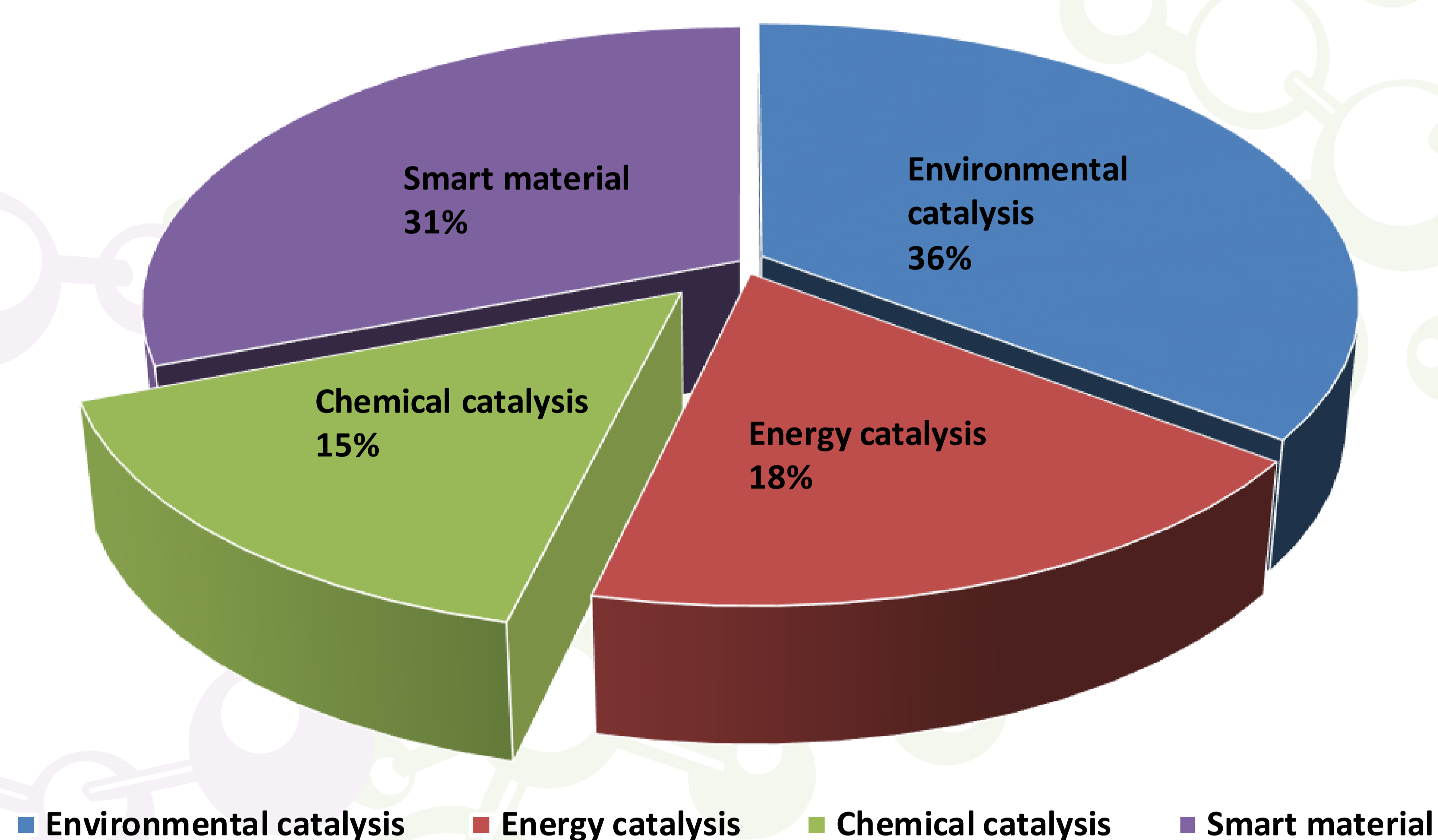
Inaugural Lecture event was graced with the poster and research services exhibition by Nanocat research team, academicians and students.



## Research Fundings

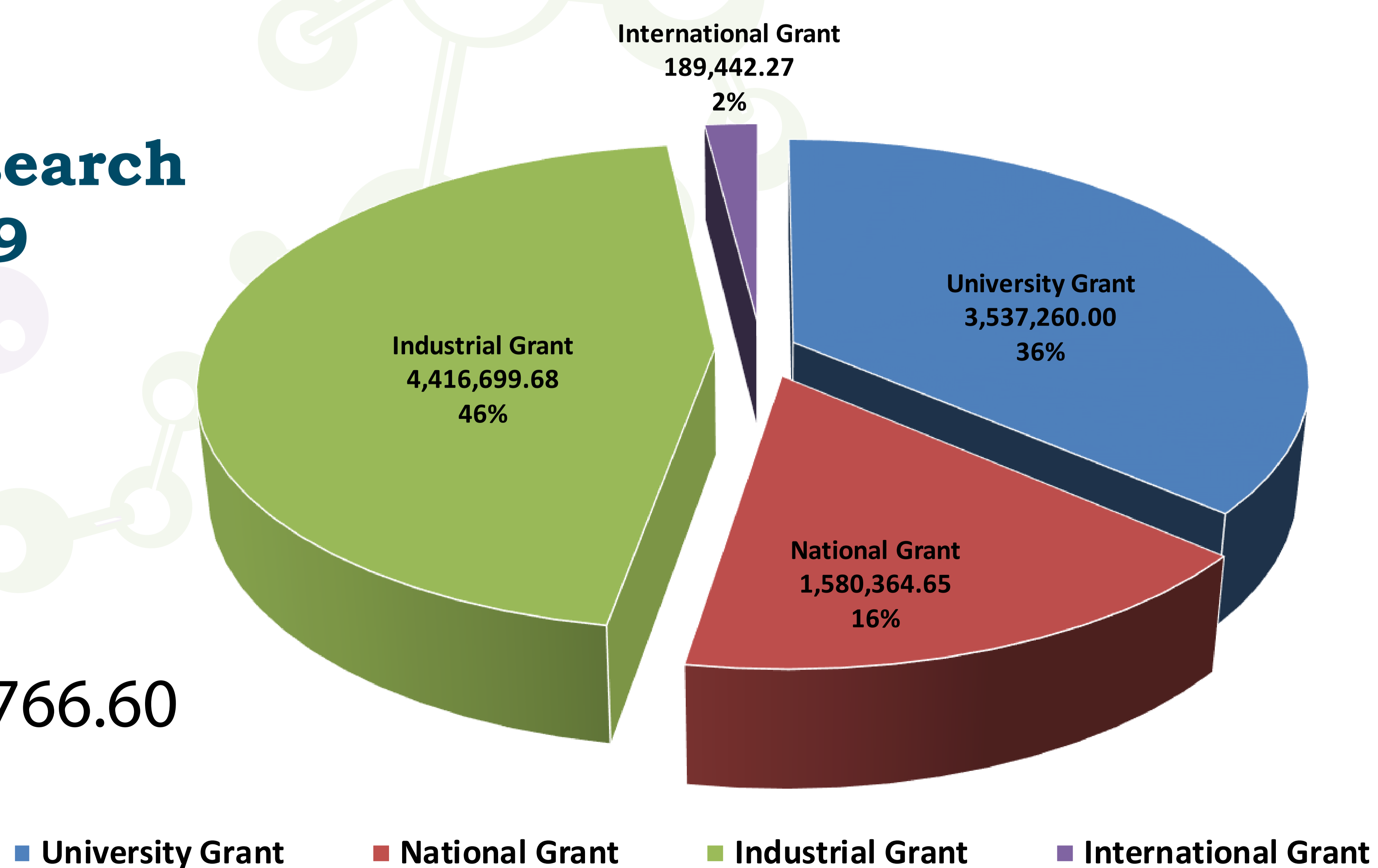
As a national research centre focused on nanotechnology and catalysis research areas, NANOCAT has come out with a strategic planning in research grant application. With that in mind, the emphasis has been given to four niche areas of NANOCAT which are environmental, smart materials, chemical synthesis and energy. This has been clearly translated to the active research grant 2019 secured by NANOCAT academic staff, which out of RM RM 9,723,766.60 total amount of research funding received, 36 % was contributed by the environmental catalysis field, 31 % by smart materials, 18 % by energy catalysis, and 15 % by chemical catalysis. The focused of research grant sources selection for NANOCAT Research Center is based on the Industrial grant, UM Research Grant, National Grant, and International Grant with the amount percentage of 46 %, 36 %, 16 % and 2 %, respectively. With this amount of funding received, NANOCAT research thrust could progressively developing and serving catalysis and nanotechnology research not only in Malaysia basis but also over the international region.

### Niche Areas 2019

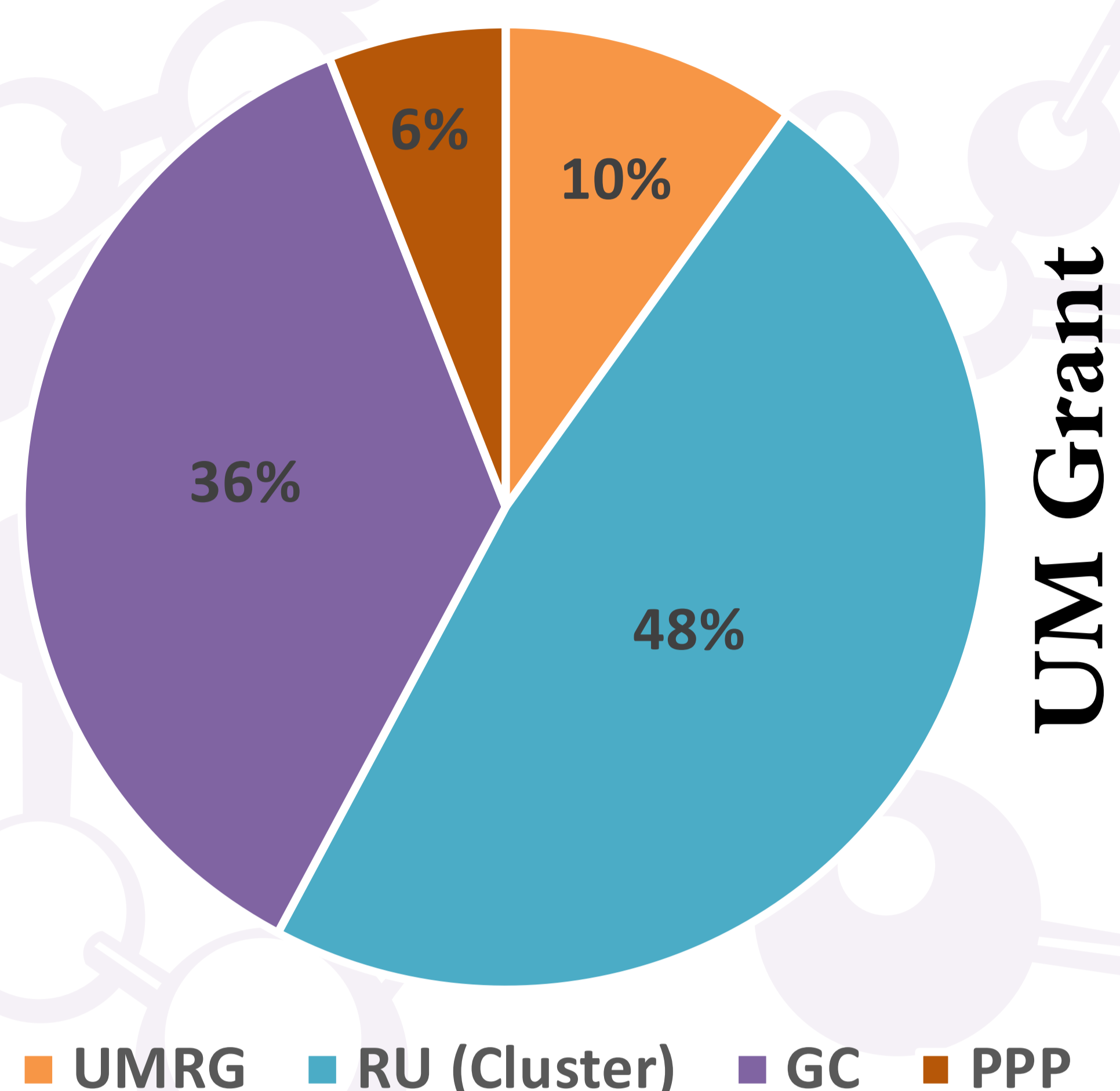


### Active Research Grant 2019

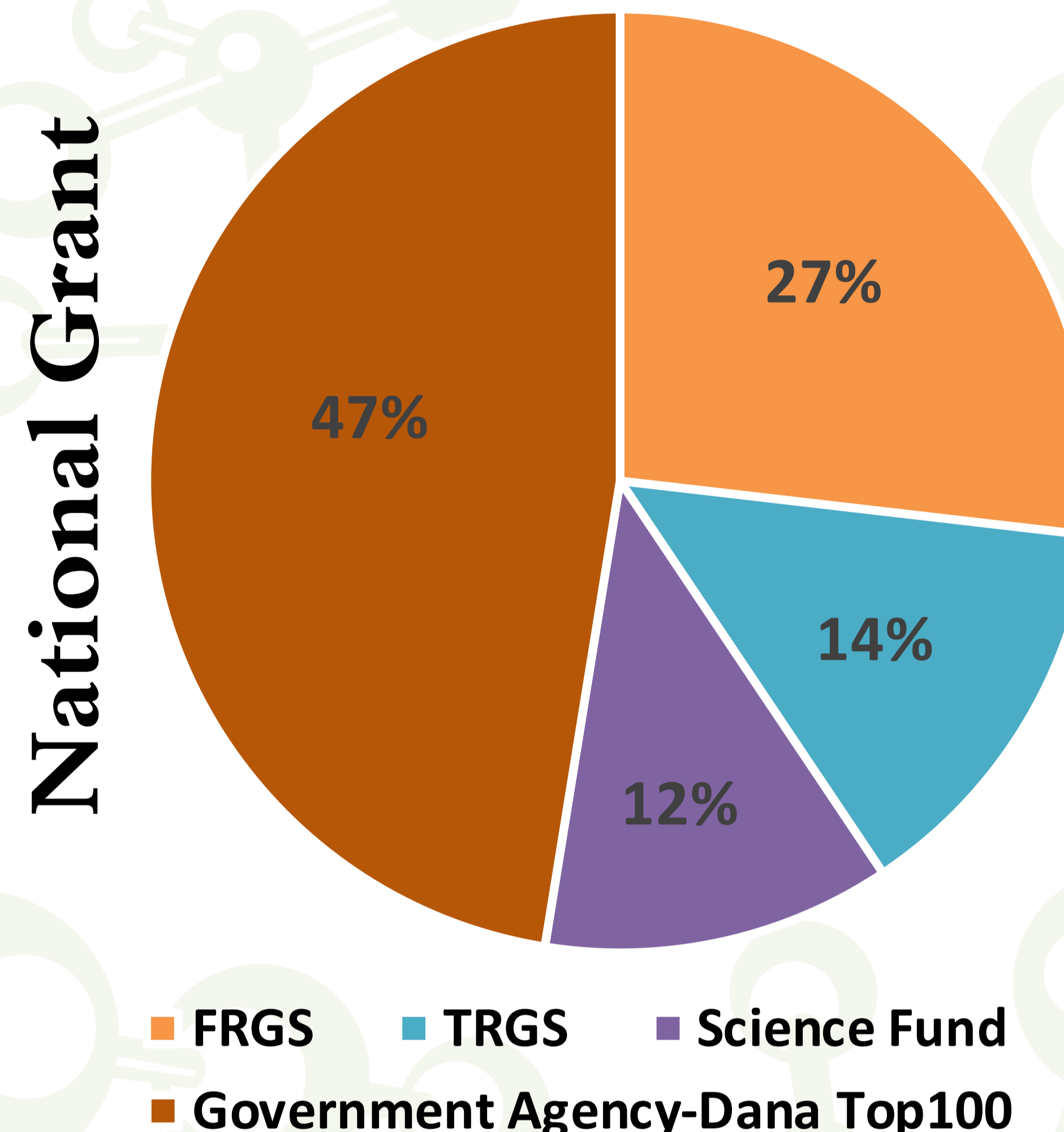
Total  
RM 9,723,766.60



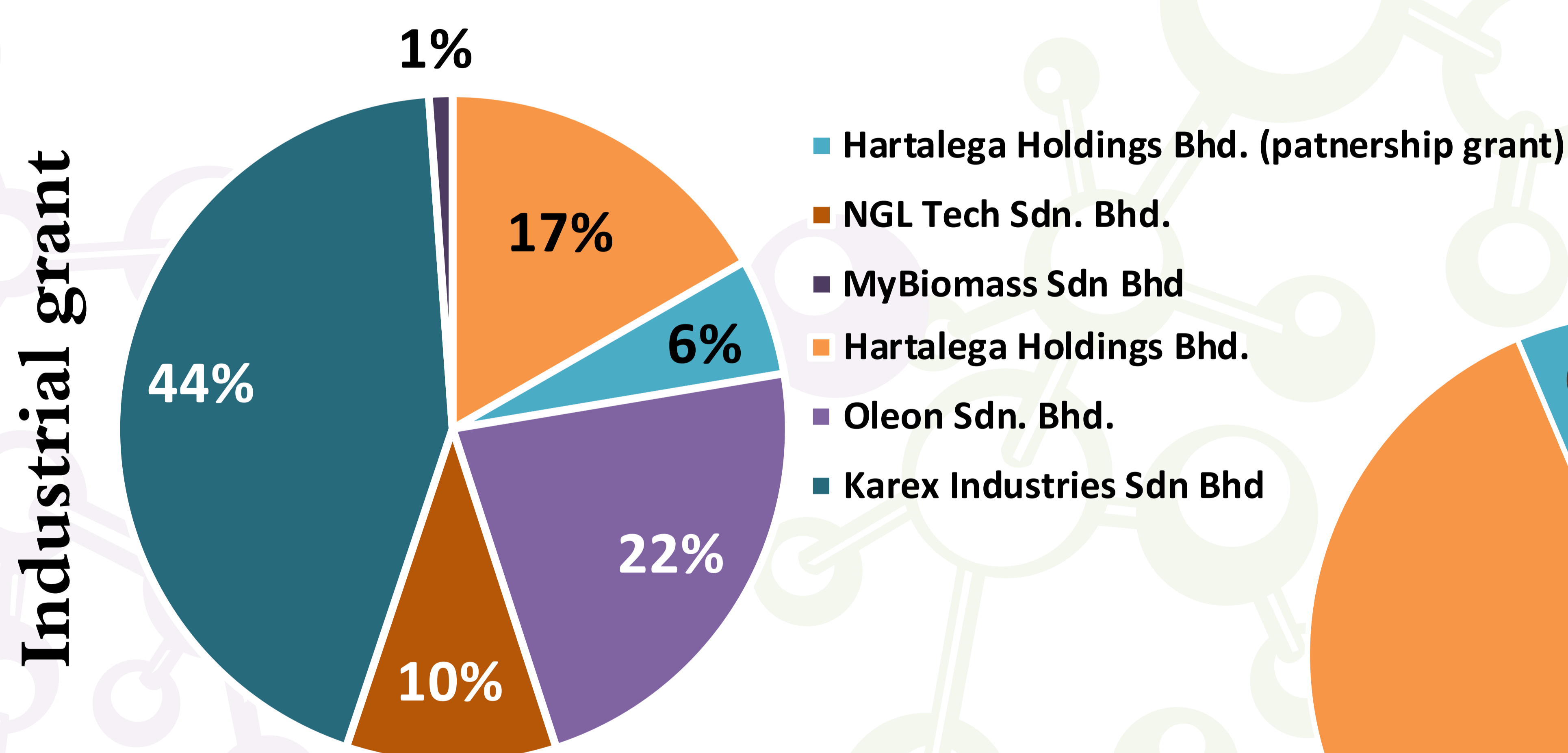
## Research Grants



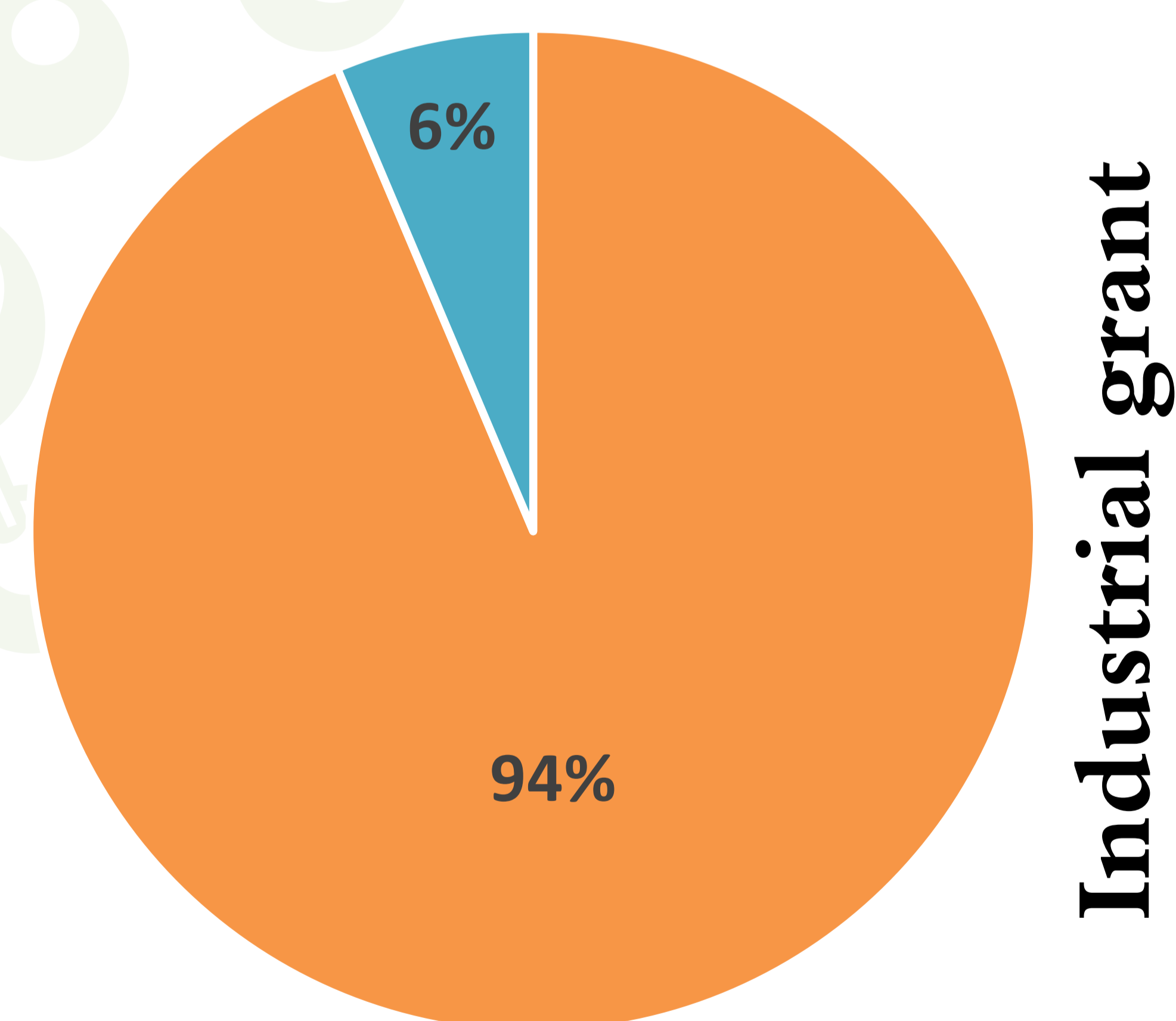
UM Grant	Amount (RM)	%
UMRG	349,600.00	10
RU (Cluster)	1,695,000.00	48
GC	1,282,400.00	36
PPP	210,260.00	6
<b>total</b>	<b>3,537,260.00</b>	<b>100</b>



National Grant	Amount (RM)	%
FRGS	424,165	27
TRGS	217,800	14
Science Fund	188,400	12
Government Agency-Dana Top100	750,000	47.5
<b>total</b>	<b>RM1,580,365</b>	<b>100</b>



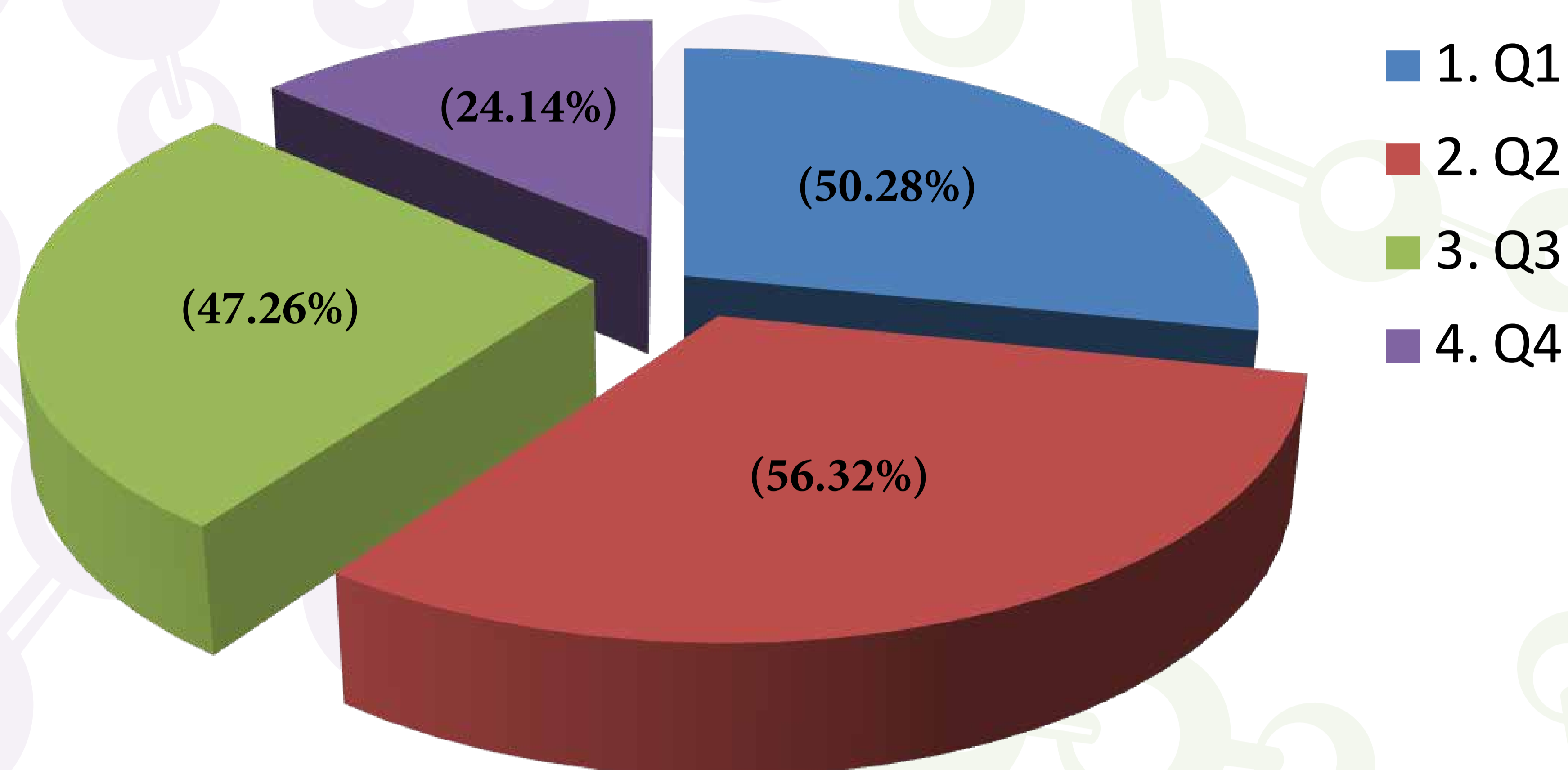
Industrial Grant/Private Funding	Amount (RM)	%
Hartalega Holdings Bhd.	737,699.68	17
Hartalega Holdings Bhd. (partnership grant)	250,000.00	6
Oleon Sdn. Bhd.	1,000,000.00	23
NGL Tech Sdn. Bhd.	447,000.00	10
Karex Industries Sdn Bhd	1,932,000.00	44
MyBiomass Sdn Bhd	50,000.00	1
<b>total</b>	<b>4,416,699.68</b>	<b>100</b>



International Grant	Amount (RM)	%
Ajinomoto Co., Inc.	177,400.87	94
Nippon Sheet Glass Foundation Japan	12,041.40	6
<b>Total</b>	<b>189,442.27</b>	<b>100</b>

# PUBLICATIONS ANALYSIS

Journal Impact Factor Quartile - Thomson Reuters (as of 30 Dec 2019)



TOTAL ISI PUBLICATIONS : **177**

Q1 & Q2: **60%**

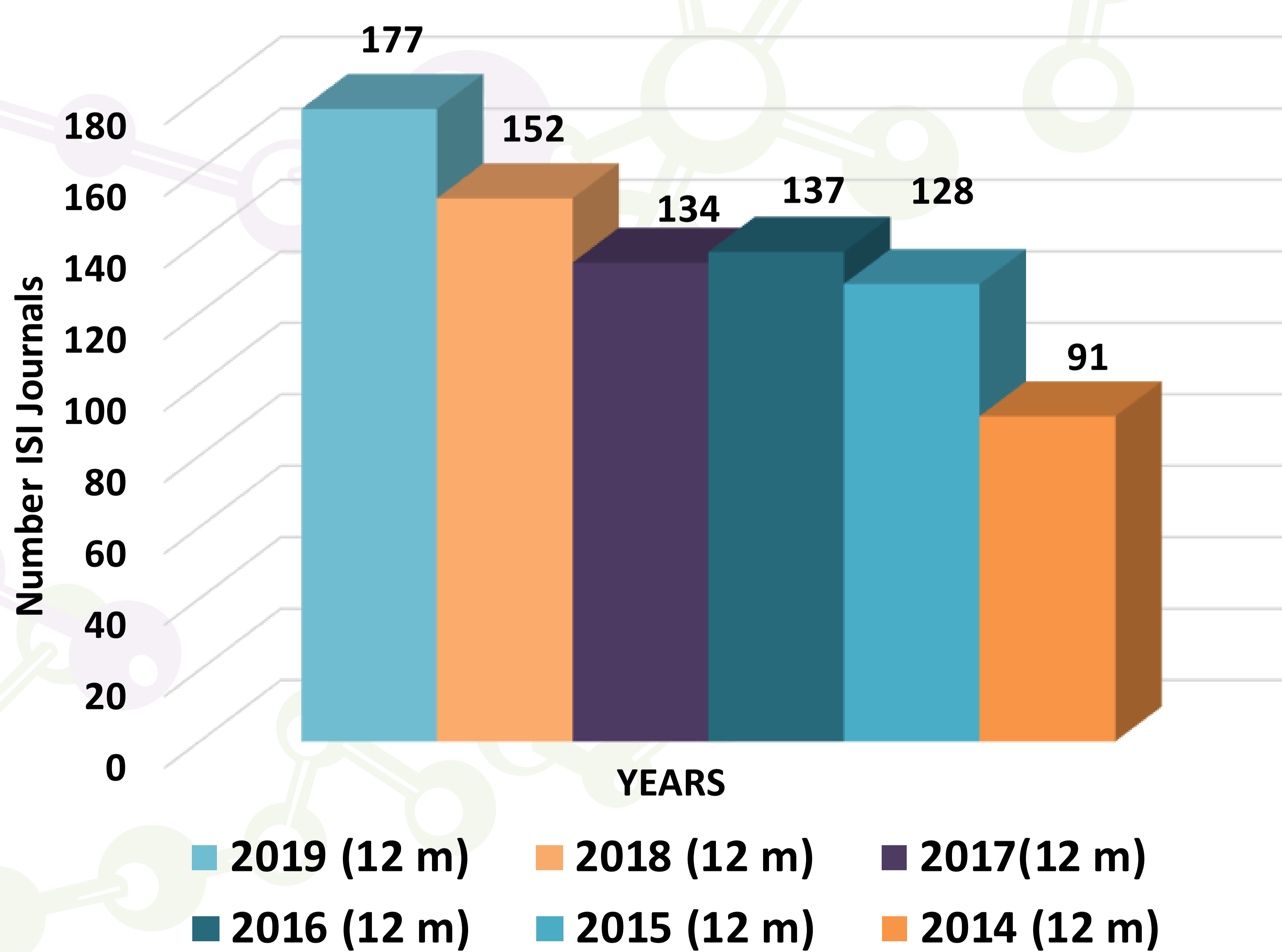
TOTAL SCOPUS : **6** (4 % from total list of publication)

NANOCAT quality objectives: ISI % = **96%**

**\*\*TARGETED Q1 & Q2 PAPERS : > 70%**

**\*\*TARGETED ISI PAPERS : > 130**

ISI PAPERS\_NANOCAT (UM) INDEXED IN WOS (2014 – 2019)



Targeted number of ISI Journals in 2019: > 130

# Research Facility

## Spectroscopic Hall

The Spectroscopic Hall, a laboratory within NANOCAT, focuses on determination of physical and chemical structural properties, chemical properties, morphological and texture properties, for liquid, semisolid and solid samples.



**In-situ Differential Scanning Calorimetry**



**Thermogravimetric Analysis-Mass Spectrometry**



**Differential scanning calorimetry**



**Vibrating Sample Magnetometer & Hall Effect**



**UV-Vis Spectroscopy**



**Raman Spectroscopy**



**In-situ Fourier Transform Infrared Spectroscopy**



**Scanning Electron Microscope**



**Fourier Transform Infrared Spectroscopy**

## X-Ray Hall

X-Ray Hall provide a non-destructive technique to determine phase composition of solid materials.



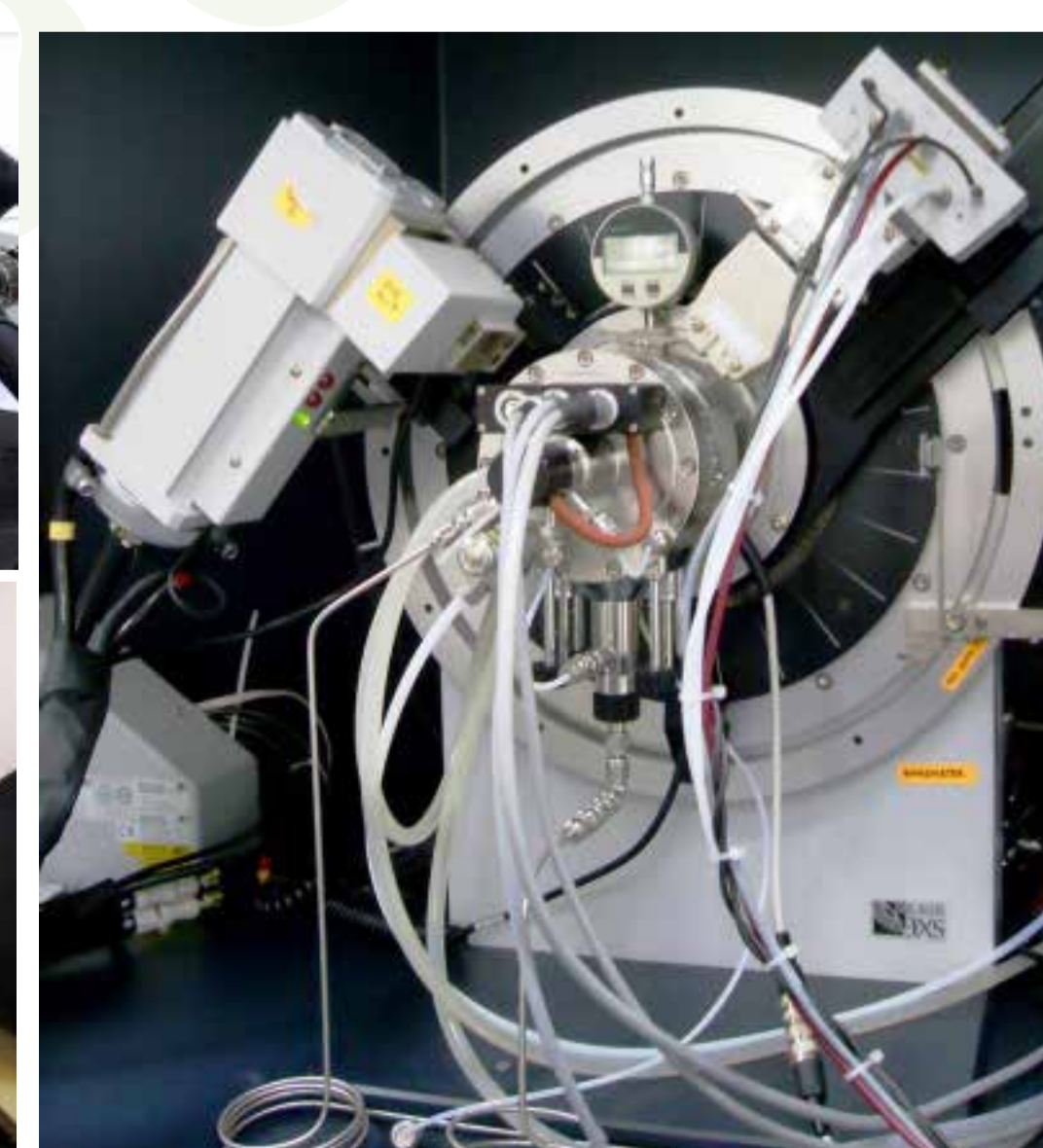
**X-Ray Diffractometer (XRD)**



**X-Ray Fluorescence (XRF)**



**In-situ X-Ray Diffractometer (XRD)**



# Research Facility



FIXED BED REACTOR (SELOX)



AUTOCLAVE REACTOR

## Reactor Hall

Reactor Hall focuses on catalytic performance screening and testing especially for petrochemical & bio oil industries. Equipped with GC to quantitatively analyze the reaction products to study the reaction mechanism allowing a reaction selectivity and yield to be optimized.



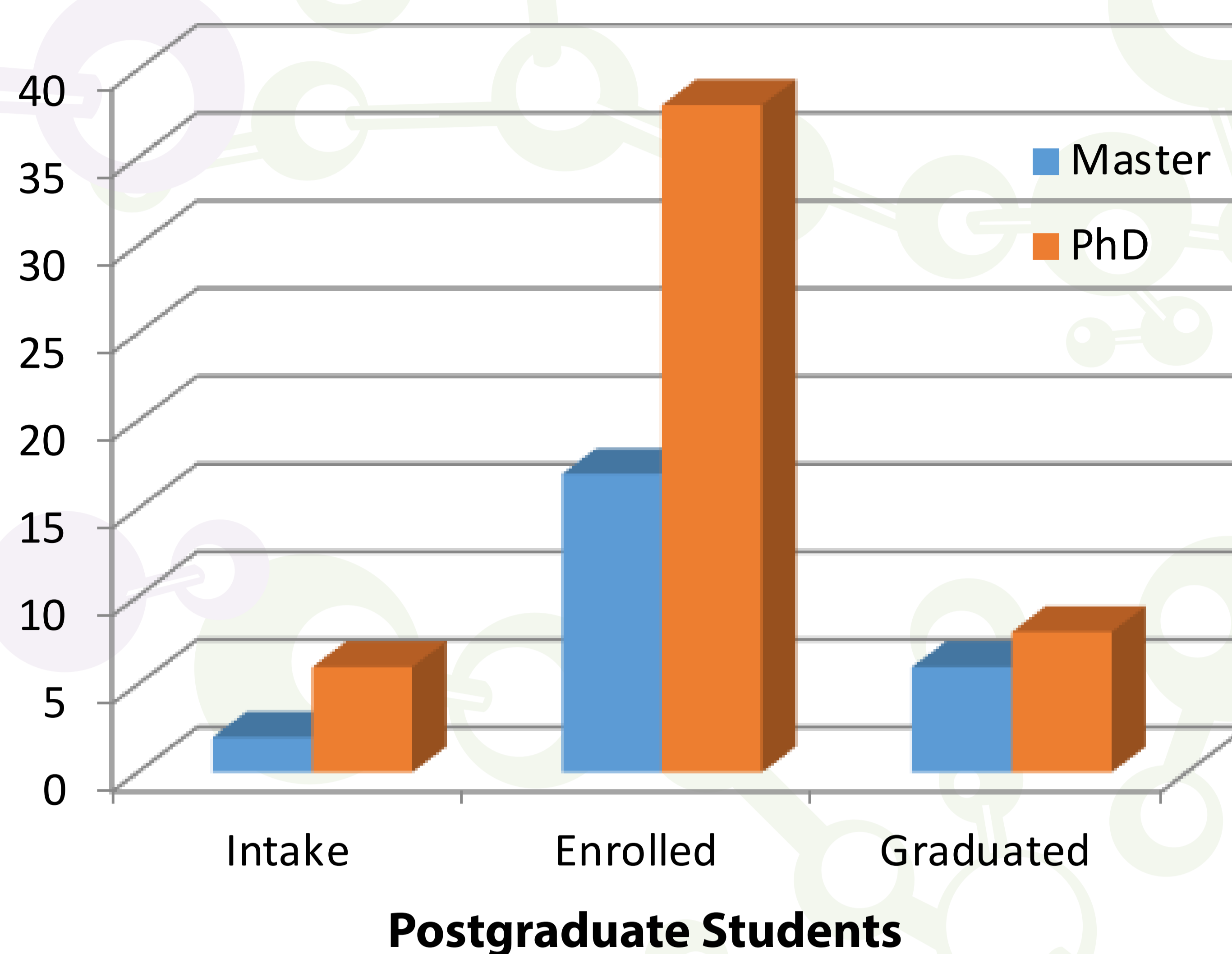
TRICKLED FLOW REACTOR (TFR)



CONTINUOUS STIRRED TANK REACTOR (CSTR)

## Postgraduate Students

NANOCAT is highly active in postgraduate supervision and research. These students, both from local and international, serve as important backbone to support the exponential growth of our centre's research activities and outputs. With 13 academic staff, NANOCAT takes pride to attract and supervise 77 postgraduate students (52 PhD and 25 MPhil) where 14 of them successfully graduated in 2019 (8 PhD and 6 MPhil). 94% of them with CGPA > 3.0 are study in NANOCAT under various financial aids and scholarship. As a global choice of research centre of excellent, 19% of them are international postgraduate students. This is indeed an achievement as part of the effort to promote UM at international level.



### 8 PhD completions

No	Matric No.	Name
1	HHC140003	Dr. Nina Naquiah Binti Ahmad Nizar
2	HHC140005	Dr. Saba Afzal
3	HHC150003	Dr. Amit Ranjan Nath
4	HHC150008	Dr. Mustafa Mohammed Khalaf
5	HHC150012	Dr. Sharmin Sultana
6	HHC150013	Dr. Md. Anwar Hossain
7	HHC150018	Dr. Seef Saadi Fiyadh
8	HHC120016	Dr. Syazwan Hanani Binti Suhaimy

### 6 MPhil completions

No.	Matric No.	Name
1	HGA140019	Nora Izzati Mohd Razip
2	HGA140024	Aizat Azhari Bin Mohd Yatim
3	HGA150022	Ignatius Julian Dinshaw
4	HGA160002	Joshua Soo Zheyang
5	HGT150011	Thillai Punitha A/P Segaran
6	HMA170013	Ivy Heng

## Awards and Distinctions

This has been a rewarding year for NANOCAT in which we have achieved 14 awards (10 National and 4 International). This demonstrated that contribution from NANOCAT is well recognized. Besides, NANOCAT is not only being recognized locally but also internationally with over 100 international recognition and professional service since 2013.

### Notable Awards

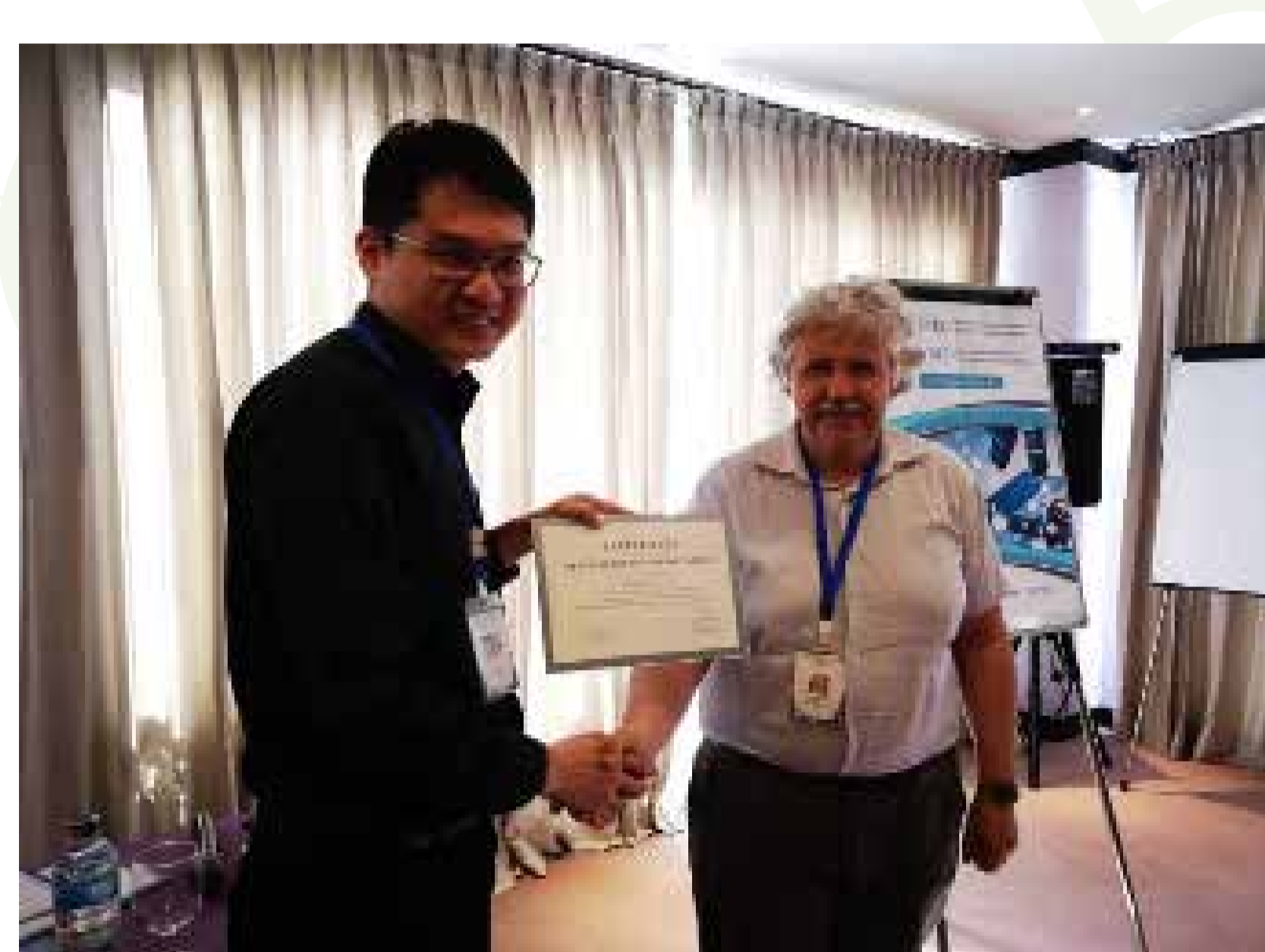


**AMONG THE WORLD  
TOP ANALYTICAL  
CHEMIST, JAPAN  
SOCIETY OF ANALYTICAL  
CHEMISTRY**  
Prof. Dr.  
Wan Jeffrey Basirun

Prof. Dr. Wan Jeffrey Basirun, Deputy Director on the Notable Award received: Among the World Top Analytical Chemist, Japan Society of Analytical Chemistry.



Assoc Prof Dr Juan Joon Ching, for being awarded for highest Industry Grant at Aungerah Cemerlang, University of Malaya on 19th December 2019.



NANOCAT has won Ir. Dr. Lai Chin Wei, Senior Lecturer for being awarded as Excellent Oral Presentation at 3rd International Conference on Innovative Engineering Materials (ICIEM 2019) on April 25th-27th, 2019 in Bali, Indonesia, Lina Adnan Al Lani, PhD student on winning best poster presentation at ASEAN Emerging Researchers, Assoc Prof Dr. Yarub Al-Douri for being selected as a recipient for Y2019 JSPS Invitational Fellowships for Research in Japan (Short-term), Pauline Phoon, PhD student winning the Global Challenge Award by the Institute of Engineering and Technology (IET) for their tempeh-inspired packaging, Mr Muhamad Syamim Akmal Che Mansor, PhD student on winning Best Poster Award in National Symposium on Micro-Nano Technology (NaSMINT) 2019. Mr Mohd Azam Mohd Adnan, Mr Muhammad Nur Iman Amir, and Mr Mohd Rashid Yusof Hamid won the Gold Award, Innovation & Best Award in Innovation Category at Melaka International Intellectual Exposition 2019, etc



## Internationalization & Networking

NANOCAT has invited well known scientist from national and international to give seminar and workshop. For examples, we have invited Prof Wataru Ueda, Prof Geoff Thornton, Prof. S. Arumugam, etc. Our smart and strategic partnership is part of our initiative in internationalization and to gain visibility. The increasing number of international eminent scientists visiting NANOCAT, is another achievement witnessing world class scientists such as Prof P. Pramanik, Prof G. Centi, Prof Ning Yan, and others spending time in NANOCAT. Besides, NANOCAT has also actively engaged with industry to secure research collaboration.



Assoc. Prof. Hélène Bertrand



Prof Dr Suresh Kumar Bhargava



Assoc. Prof. Haliza Katas



Prof. Sivakumar Manickam



Prof. S. Arumugam



Prof. Wataru Ueda



Prof. Geoff Thornton

## Collaborators



Intensification in networking and research collaboration were formalized through 17 MOUs (7 national and 10 international), 9 MOAs (5 national and 4 international). The co-operation has given mileage for joint publications in WoS journals with high impact. Hartalega, Karex and Oleon have further extended cooperation. NANOCAT members actively support and sit in the committee of various government initiatives such National nanotechnology Directorate (NND) of MOSTI, NanoMalaysia Berhad, NanoCentre Malaysia, Akademi Sains Malaysia, Institut Kimia Malaysia, etc.



## Collaborators

### MOU

#### **(i) International**

- University of Surabaya, Indonesia.
- Flinders University, Australia.
- University of Messina, Italy.
- National Research Tomsk State University, Russian Federation.
- Shenyang National Laboratory for Materials Science, China.
- Guilan University, Iran.
- University of the Western Cape, South Africa.
- Iraqi Forum for Intellectures and Academics, Turkey.
- Peace University, The Republic of The Sudan.
- Wajufo Investment Holdings Co. Ltd, China.
- Cihan University Sulaimaniya, Iraq.
- Corporation of Research and Industrial Development, Iraq.
- Tikrit University, Iraq.

#### **(ii) National**

- Universiti Malaysia Sarawak (UNIMAS)
- Universiti Sains Malaysia (USM)
- Universiti Malaysia Perlis (Unimap)
- Universiti Teknologi Mara (UiTM)
- Universiti Tunku Abd Rahman (UTAR)
- Universiti Tun Hussein Onn Malaysia (UTHM)
- Universiti Teknologi Petronas

### MOA/NDA

#### **(i) International**

- UMT-Uni of Nottingham-UKM-Airbus, UK.
- University of Dhaka, Bangladesh.
- Ajinomoto Co. Inc., Japan.
- Kanagawa University, Japan.
- University of Mohamed Boudiaf M'Sila, Algeria.

### MOA/NDA

#### **(ii) National**

- Hartalega Research Sdn Bhd.
- Karex Industries Sdn Bhd.
- Oleon Sdn Bhd.
- NGL Tech Sdn Bhd.
- Universiti Tun Hussein Onn Malaysia (UTHM).

## Publications 2019

### Journal Articles (Q1)

1. Khaligh, N. G., Teng, L. S., Ling, O. C., Johan, M. R., & Ching, J. J. (2019). **4-Imidazol-1-yl-butane-1-sulfonic acid or a novel liquid salt? The NMR analysis and dual solvent-catalytic efficiency for one-pot synthesis of xanthenes.** *Journal of Molecular Liquids*, 278, 19-32.
2. Khaligh, N. G., Mihankhah, T., & Johan, M. R. (2019). **Synthesis of new low-viscous sulfonic acid-functionalized ionic liquid and its application as a Brönsted liquid acid catalyst for the one-pot mechanochemical synthesis of 4H-pyrans through the ball milling process.** *Journal of Molecular Liquids*, 277, 794-804.
3. Akinpelu, A. A., Ali, M. E., Johan, M. R., Saidur, R., Qurban, M. A., & Saleh, T. A. (2019). **Polycyclic aromatic hydrocarbons extraction and removal from wastewater by carbon nanotubes: A review of the current technologies, challenges and prospects.** *Process Safety and Environmental Protection*, 122, 68-82.
4. Sookhakian, M., Basirun, W. J., Goh, B. T., Woi, P. M., & Alias, Y. (2019). **Molybdenum disulfide nanosheet decorated with silver nanoparticles for selective detection of dopamine.** *Colloids and Surfaces B: Biointerfaces*, 176, 80-86.
5. Choong, C. E., Ibrahim, S., & Basirun, W. J. (2019). **Mesoporous silica from batik sludge impregnated with aluminum hydroxide for the removal of bisphenol A and ibuprofen.** *Journal of colloid and interface science*, 541, 12-17.
6. Low, L. E., Tan, L. T. H., Goh, B. H., Tey, B. T., Ong, B. H., & Tang, S. Y. (2019). **Magnetic cellulose nanocrystal stabilized Pickering emulsions for enhanced bioactive release and human colon cancer therapy.** *International journal of biological macromolecules*, 127, 76-84.
7. Abdulkareem-Alsultan, G., Asikin-Mijan, N., Mansir, N., Lee, H. V., Zainal, Z., Islam, A., & Taufiq-Yap, Y. H. (2019). **Pyro-lytic de-oxygenation of waste cooking oil for green diesel production over Ag<sub>2</sub>O<sub>3</sub>-La<sub>2</sub>O<sub>3</sub>/AC nano-catalyst.** *Journal of analytical and applied pyrolysis*, 137, 171-184.
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