

1st KFUPM Annual Research Day
Nanotechnology
 Research on Campus

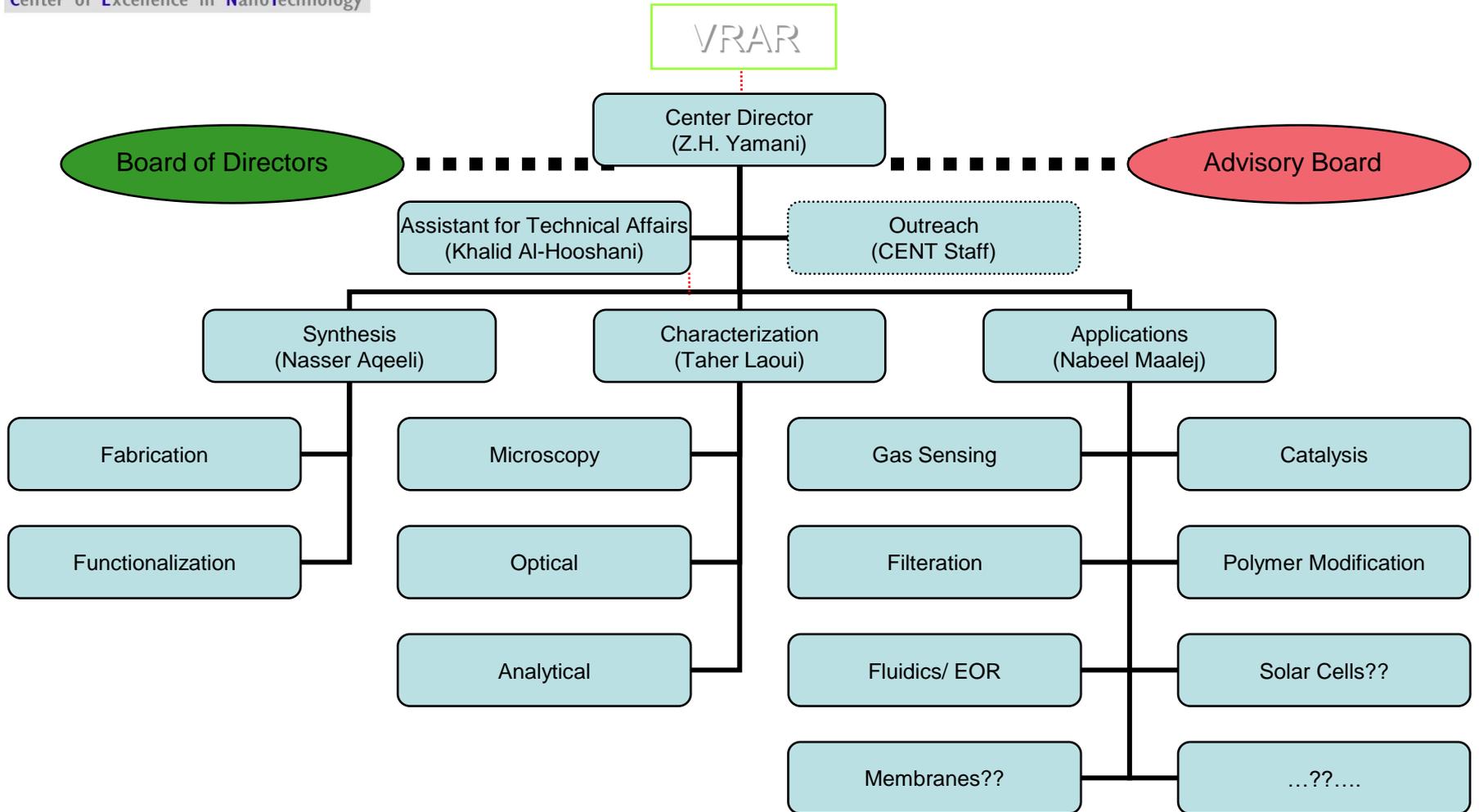
Zain Yamani
CENT Director
 18-5-1431



Funding Organs/ programs

- CENT
- MIT Collaboration
- DSR
- NSTIP program
- KACST Annual
- TIC

CENT structure



CENT: Vision and Mission

Vision:

CENT shall be an internationally recognized leading research center that develops innovative research and cutting edge knowledge in the field of Nanoscience and Nanotechnology

Mission:

CENT will be the platform through which KFUPM shall develop a Nanotechnology Program that enables its scientists and faculty members to carry out world-class Nanoscience and Nanotechnology based research in areas of strategic importance for the Kingdom, and support the same through teaching at KFUPM

CENT: Objectives

1. To build up a world class human resources research capacity including highly qualified scientists and staff and trained graduate students in the field of nanomaterials synthesis and their characterization & applications.
2. To develop a research infrastructure including state of the art facilities that enables the Center to achieve its goals.
3. To develop **innovative nanotechnology-based solutions in strategic areas for the Kingdom related mainly to petroleum and petrochemical industries.**
4. To establish Industrial Partnerships with relevant companies and entrepreneurships as a step toward commercialization, in coordination with DTV.
5. To contribute to the development of teaching graduate programs and training students in the field of nanotechnology.
6. To promote public awareness regarding the benefits and the risks of nanotechnology.

CENT Affiliates:

Abdullah Al-Sultan
Abdul-Nasir Kawde
Anwar-ul-Hamid
Ahsan-ul-Haqq
Bassam Tawabini
Belabbes Merzougi
Khalid Arafah
Khalid Al-Hooshani
Nageh Allam
Oki Muraza
Nouar Tabet
Nasser Aqeeli
M. Ashraf Gondal
Muataz Ali Atieh
Tahar Laoui
Mazen Khaled
Nabeel Maalej
Saheb Nouari
Qamar Azmi
Saleh Al-Quraishi
Syed Ahmed Ali
Zain Yamani

PETE
Chemistry
CER
CENT
ES
CENT
CENT
CENT/ Chemistry
CENT
CENT
Physics
Mech. Eng.
Physics
Chem. Eng.
Mech. Eng.
Chemistry
Physics
Mech. Eng.
CENT
Physics
CRP
CENT/ Physics

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hooshani@kfupm.edu.sa
Nageh.Allam@gmail.com
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natabet@kfupm.edu.sa
nageeli@kfupm.edu.sa
magondal@kfupm.edu.sa
motazali@kfupm.edu.sa
tlaoui@kfupm.edu.sa
mkhaled@kfupm.edu.sa
maalej@kfupm.edu.sa
nouari@kfupm.edu.sa
gamar@kfupm.edu.sa
salehq@kfupm.edu.sa
ahmedali@kfupm.edu.sa
zhyamani@kfupm.edu.sa

There is an ad-hoc committee appointed, and a proposal almost finalized for a recommendation on a Clean Room Facility

Main sponsors: CoRE-RE, CENT

Contact: Dr. Amir Abdullah

Can there be nanotechnology without a Clean Room??

Chemical Synthesis

Characterization

Of course.. YES!!

Nanopowder
Metallurgy

Nano-Materials Development

Applications Lab

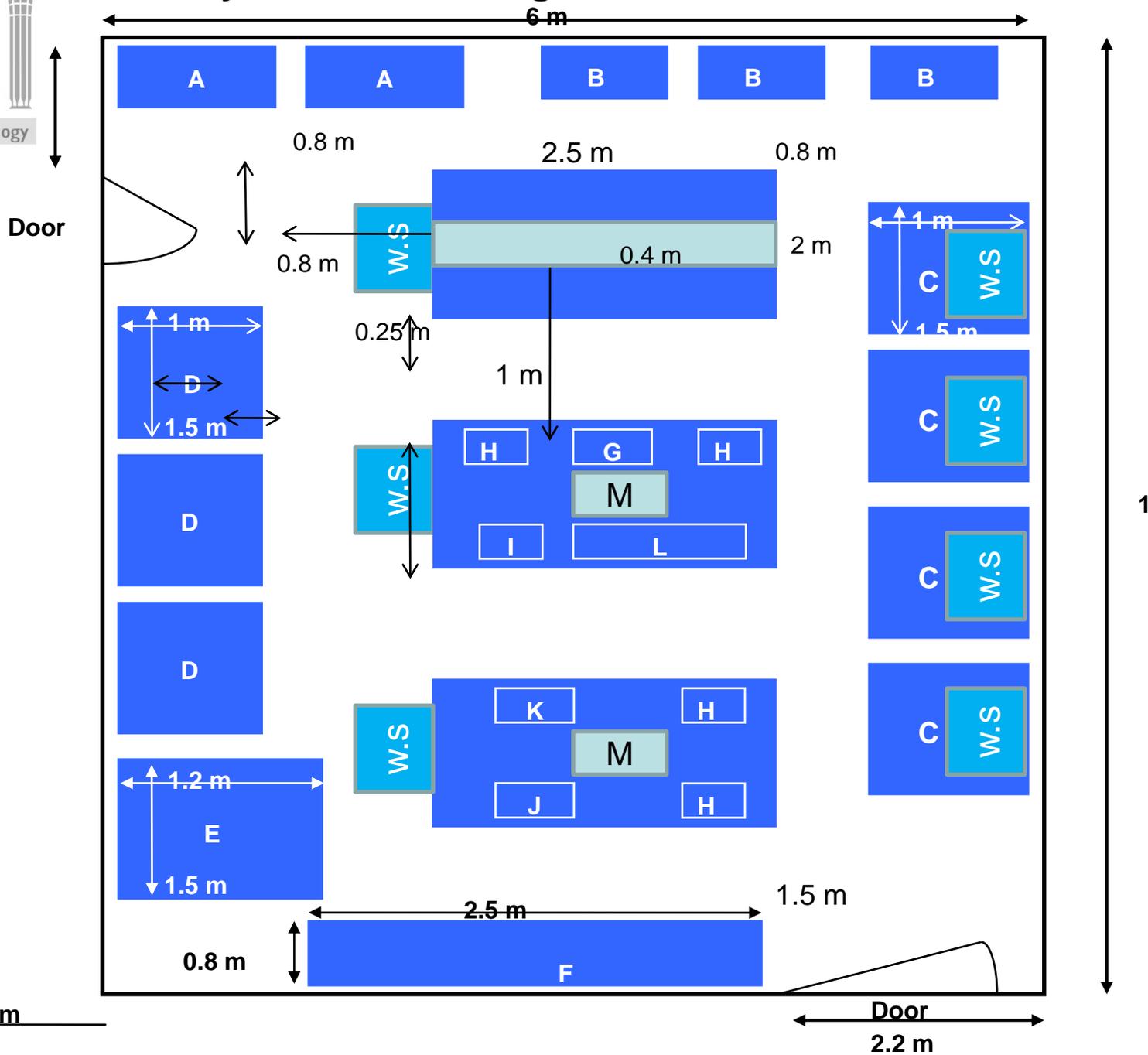
Building-1, rooms: 116B, 116A, 119, 120

Satellite Labs

Production Lab

Contact: Dr. Khalid Al-Hooshani

Synthesis Lab. Bldg 1 Room 116B



CENT Areas of Focus

focusing on the petroleum and petrochemical industries.

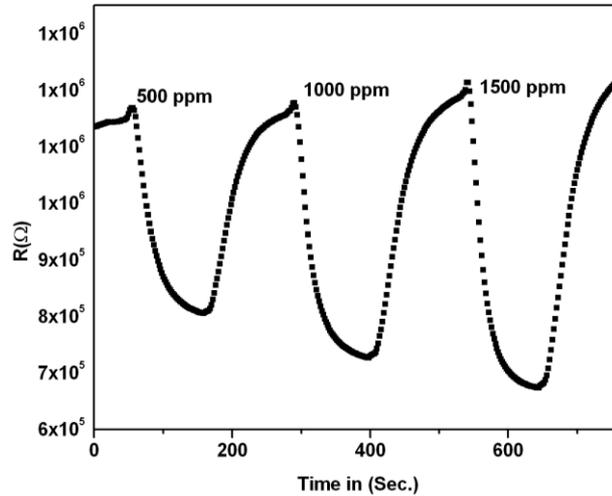
1. Nano-engineered Catalytic and Photocatalytic Materials
2. Nano-structured Materials for Sensing Applications
3. CNT Applications



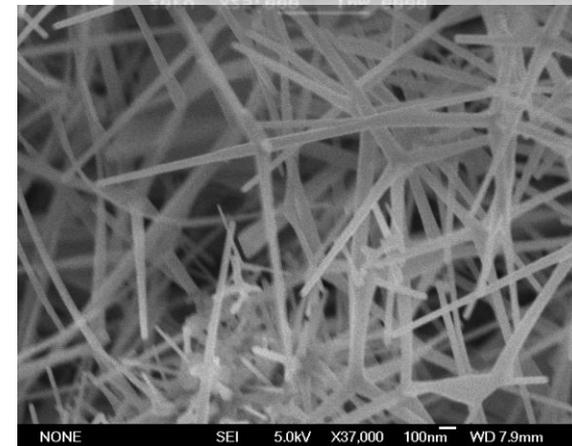
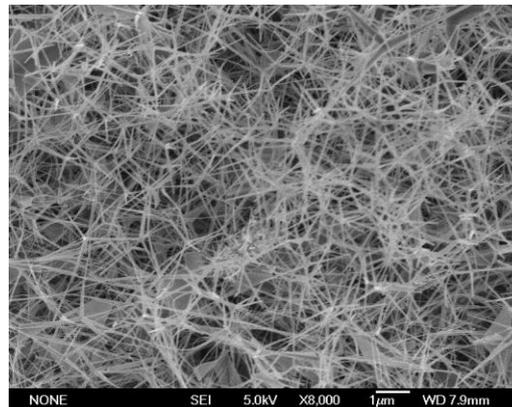
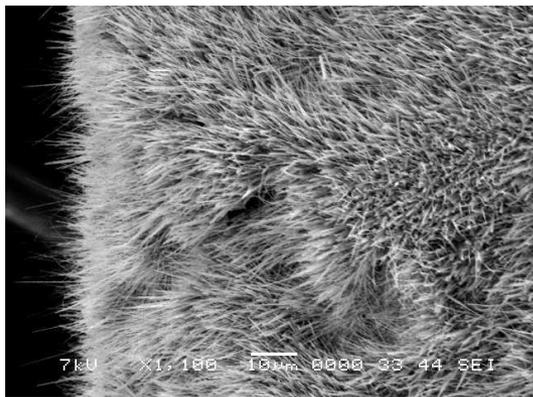
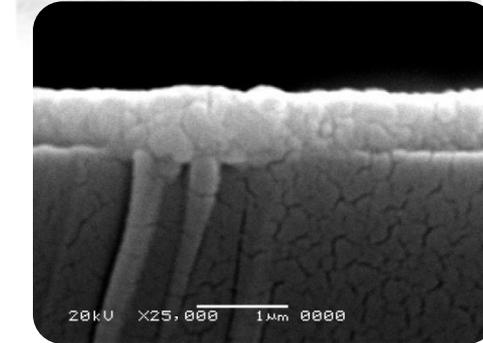
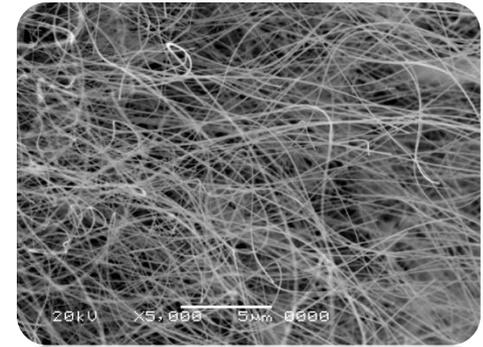
Zinc Oxide Nanowires/ Nanodots

N. Tabet et. al (Physics & CENT)

Dynamic and fast response of MW ZnO nanowires to H₂ gas at different temperatures



Operating temp. 200°C temp.
 Measured by Dr Ahsan,
 Tokayama, Japan, Oct. 2008.
 Unpublished





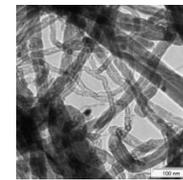
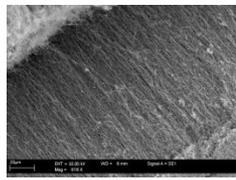
Nano-Carbon Research Unit

Applications

Synthesis and Characterization

Fabrication and Design of Reactors





NCRU applications

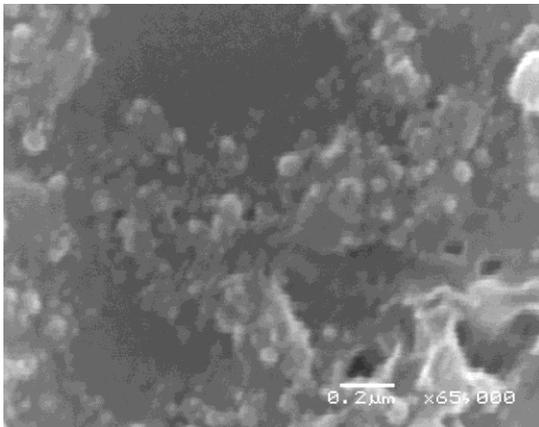
- Improving of the mechanical properties of composite polymers
- Catalyst for polymerization (or inhibition)
- Developing rubber super tires
- Improving heat exchanging
- Water decontamination



Pulsed Laser Ablation for synthesis of nanostructures



video

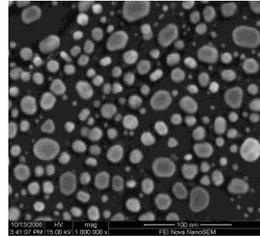


Running CENT projects (2008)

#	Title	Focus Area	PI	e-address
1	<u>Biocide properties of novel polyelectrolytes nanofilms</u>	Nano-Bio	Mazen Khaled	mkhaled@kfupm.edu.sa
2	<u>Production of Carbon Nanotubes (CNTs) by using Gas/Solid Atomizer Chemical Vapor Deposition (GSA-CVD) for Nanocomposite Application</u>	CNT	Mo'taz Ali	motazali@kfupm.edu.sa
3	<u>Study of the Structural Properties and Hydrodesulfurization Activity of MoS₂ and Co/MoS₂ Catalysts Prepared by Laser Pyrolysis</u>	Catalysis	Zain Yamani	zhyamani@kfupm.edu.sa
4	<u>Development of High Performance CNTs and SiC Reinforced Metal Matrix Nanocomposites for Pistons Applications</u>	CNT/ Corrosion	Saheb Nouari	nouari@kfupm.edu.sa

Equipment

XPS

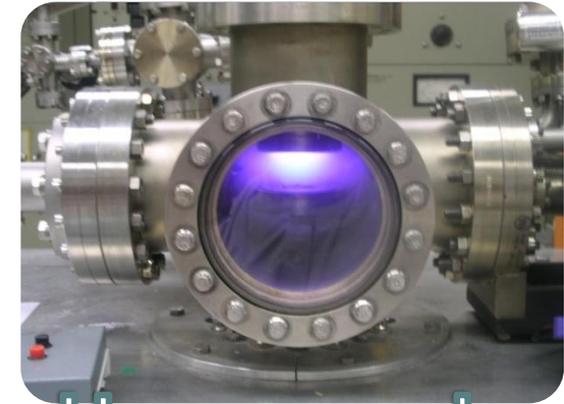


XRD

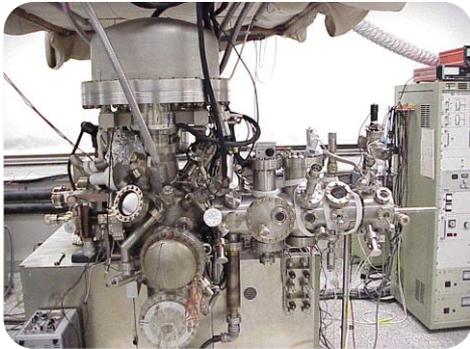


TEM

SEM



Home-made
DC-Magnetron



PS-Spectrometer

AFM/ STM

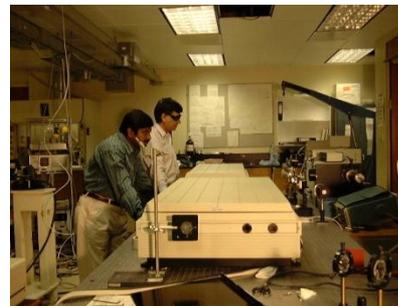


Lasers



AFM/STM

PVD/ CVD



Institutional Collaborations

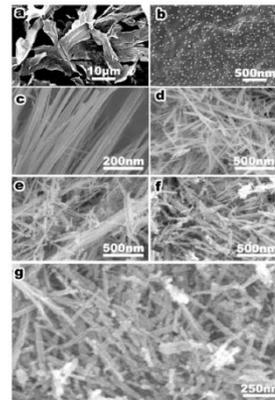
Type	Academic		Industrial
Domestic	Dammam Univ.		S. Aramco up-stream
	KFU		S. Aramco down-stream
	KAUST		Tasnee
International	CISM	CEA	RTI (potentially)

Project Title: Study of the Structural Properties and Hydrodesulfurization Activity of MoS₂ and Co/Ni/MoS₂ Catalysts Prepared by Laser Pyrolysis

Investigators:	PI: Zain Yamani ⁽¹⁾ Co-I: N. Tabet ⁽¹⁾ , Co-I: S. Ali ⁽²⁾ Frederick Schuster ⁽³⁾ Hicham MASKROT ⁽³⁾ (1) Center of Excellence in Nanotechnology and Physics Department, KFUPM (2) Center for Refining and Petrochemicals, KFUPM (3) Advanced materials Program, CEA-France
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Fabrication of NP
 Impregnation
 Characterization
 Testing for HDS

A 3-way collaboration, a subject that is important to the Kingdom, potentially supported by the Industry, potential IP ownership, not that much overhead



Adv. Mater. 2006, 18, 2561–2564

By Fangyi Cheng, Jun Chen,* and Xinglong Gou

SIC → 1.3 kg/h TiO₂ → 0.2 kg/h, > 1 kg/h (2007)

Reactants
 Gas
 Liquids
 Solids: indirect way

At Laboratory scale
 Single Phases: carbides (SiC, TiC, B₄C,...), nitrides (Si₃N₄, BN,...), oxides (TiO₂, Fe₂O₃,...), fullerenes (C₆₀, C₇₀,...), metals (Fe, Co,...)
 Composites: SiC/B, SiC/Ti, SiC/N, SiC/N/B, SiC/N/Al/Y,...

Schuster, CEA-France

We like to build a larger teams in the field of nano-engineered catalysis

Currently, CENT is building (human and hardware) capacity in:

1. Nano-engineered materials for Catalysis, especially for:

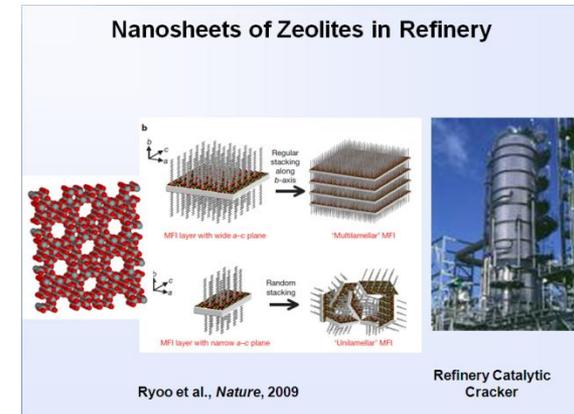
- a. HDS
- b. CO₂ conversion
- c. for polymerization
- d. photocatalysis

2. Gas sensing (of H₂S, H₂, SO_x, NO_x, or otherwise)

3. Environmental applications (especially water decontamination)

4. Enhancing of the mechanical properties of composite polymers

5. Enhanced Oil Recovery (EOR)



CENT sponsored NSTIP Projects

[May 2010]

Development of advanced and functional nano-structured mesoporous zeolites for hydrodesulphurization and other catalytic applications in petroleum and petrochemicals

Zeolite Nanosheets as a Materials Platform for Improved Refining Catalysts

Carbon Nanofibers Grown on 3-D Solid Structures for Applications in Energy-Related Catalysis

Development and characterization of high surface area metal carbides modified mesoporous carbons and ceramics for clean fuel and catalysis applications

Development of nano-structured metal phosphides for ultra-clean fuel and fuel cell applications

Development of Nitrogen-Modified CNTs as Pt-Free Catalysts for Fuel Cells

Electrochemical engineering of nano-structured materials for clean energy and energy conversion applications

Synthesis of Metal-Organic Framework Nanostructures for uptake of CO₂ and Hydrogen Storage

Design of Smart Fluids for Acid Delivery in Well Stimulation Treatment

CENT sponsored NSTIP Projects

[May 2010]

Electrospinning of Semiconductor Metal-oxide and Polymer Nanofibres for Ultra-sensitive Amperometric Sensor

Synthesis of Mesoporous and Microporous Metal-oxides Nanostructured Materials for Hydrocarbons and NO_x Sensors

Comparative Study of Conversion of Carbon dioxide into high-value hydrocarbons using nano-structured materials by solar and laser irradiation

Development of highly efficient visible-light-driven nanostructured materials for photocatalytic applications

Photocatalytic Splitting of Water over mixed metal oxyhalides-based Catalyst using Laser Radiation

Activity of laser enhanced nano-structured oxides of tungsten, nickel, zinc, iron and titanium against Candida and Aspergillus

Lanthanide-doped oxide nanoparticles for Multi-modality Molecular Imaging Agents

Future Development

CENT could potentially develop competency in the focus area:

- o Materials development for membranes for gas separation (or otherwise)
- o Renewable energy applications (hydrogen production, or photovoltaics)
- o Hydrogen storage

Scale up: photocatalysis, CNT production

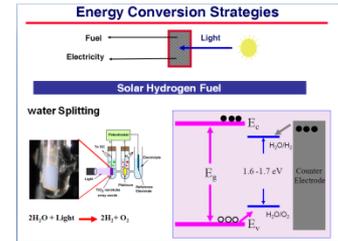
We are concentrating on:

Employment..

Facilities..

Collaborations..

Industrial partners..



Larger mesoporous supports

	Microporous (<2 nm)	Mesoporous (2-50 nm)	Macroporous (>50 nm)
	Zeolites	Silicas	Metal oxides
Diameter of Mesopores			
Surfactant	CTAB	Brij-56	Pluronic F127
Structure	$\text{C}_{16}\text{H}_{33}\text{N}(\text{CH}_2)_3\text{Br}$	$\text{C}_{18}\text{H}_{37}(\text{EO})_8\text{OH}$	$\text{EO}_{67}\text{PO}_{10}\text{EO}_{67}$
2D Hexagonal	2-3 nm	4-5 nm	6-8 nm
3D Cubic		Surfactant/SiO ₂	
3D Hexagonal		Aging time	
		Solvent evaporation conditions	
		Humidity	



Miscellaneous

Visiting professors

Bi-weekly CENT Seminars

Friends of CENT Mailing list



Visiting professors

NTGP: graduate program (under development)

www.kfupm.edu.sa/cent

web-site & forum



In closing..

KFUPM is committed to Developing Nanotechnology on Campus

We'd be happy to add you to Friend's of CENT (e-)mailing list.

Just send us a note: cent@kfupm.edu.sa

We look forward to putting our hands in yours to synergistically develop research

Do not hesitate to contact us if you have suggestions or believe there is potential for collaboration.

Thank you for your attention

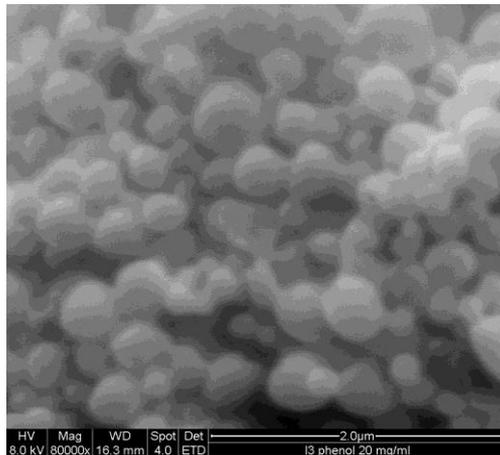


Polymer Nanoparticles for X-ray Imaging of Cancer Cells

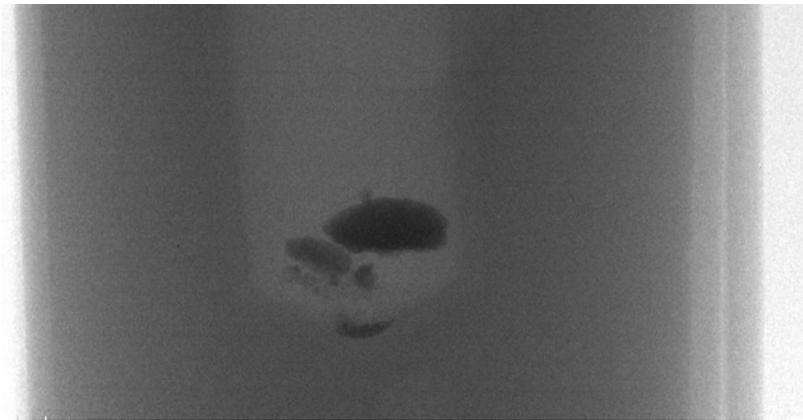
Nabil Maalej (KFUPM)

Feng Si Shen, Prashant Chandrasekharan (NUS)

Basic Idea: Encapsulate Iodine/High Z material in the polymer NPs and deliver them to the cancer cells using targeting molecules to make the cells more apparent in the x-ray image



Polymer nanoparticle
with Triiodophenol



Triiodophenol nanoparticles
Micro CT X-ray Images

CENT in bullets

- **Organization Structure**

- CENT Executives Committee
- Teams (Synthesis, Characterization, Appli
- CENT Board of Directors
- CENT Advisory Board

- Professor Sahl Abdul-Jawwad
- Dr. Mohammed Al-Humoud
- Dr. Zain Yamani
- Professor Nouar Tabet
- Professor Basel Abu-Sharkh
- Dr. Khalid Al-Hooshani
- Dr. Abdullah Al-Ja'fari
- Dr. Qasem Fallatah

- **Personnel**

- Nearly 25 KFUPM
- with CENT
- Newly appoi
- post-docs &

- **Prof. Munir Nayfeh**
President NanoSi Advanced Technology (UIUC-USA)
- **Prof. M. Ishaque Khan**
Associate Dean, College of Sciences and Letters (IIT-USA)
- **Prof. Helmut Dosch**
DESY Chairman of the Board
- Prof. Zbigniew Stachurski**
Director, Centre for Science and Engineering of Materials (ANU-Australia)
- **Dr. Khalid Al-Biyari**
Senior Vice President for R&D, Advanced Electronic Company-KSA
- **Mr. Jamal Al-Dabal**
Director, Career Development (Saudi Aramco-KSA)
- **Dr. Zain Yamani** (CENT Director)

- **Lab Utilities**

- Lab space
- Instruments
 - Campus
 - PLD, RF
- Projects

Other Activities/Programs Maintained by CENT

Bi-weekly seminars:

- Al-Somali, Bani-Yaseen,
Ahmad Omar, ...etc.

Visiting professors:

- Syed Qadri (NRL, USA)
- Collaborators/ Consultants

Developing CENT labs
on campus

Increasing Capacity

Workshops:

- CNT Applications
- X-ray Characterization Techniques

Graduate Program

More inter-Centers collaborations

Collaborations potentially with:

DuPont, Dow Chemicals, S. Aramco, SABIC
KAUST, KACST, KSU, Taibah, KFU,...etc