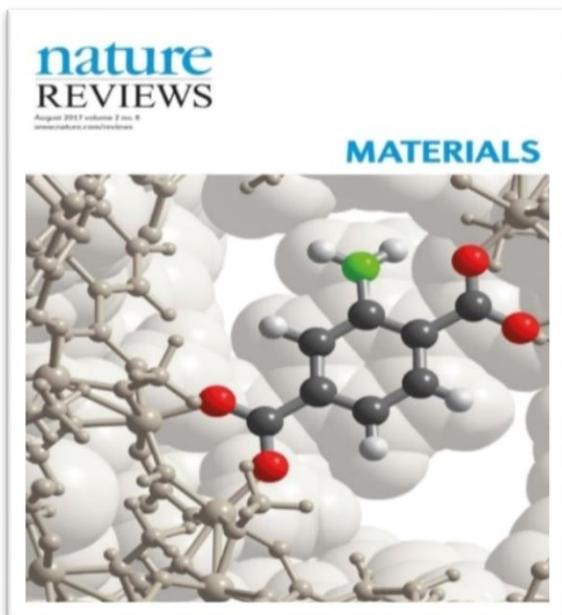


**Eid Mubarak!**

May the Blessings of Allah  
Keep your Heart & Home  
Happy & Joyous!

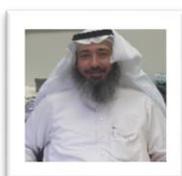


**CENT affiliated paper titled “ The chemistry of metal–organic frameworks for CO<sub>2</sub> capture, regeneration and conversion” as featured on the cover of Nature Reviews-Materials**



**Abstract** | The carbon dioxide challenge is one of the most pressing problems facing our planet. Each stage in the carbon control cycle — capture, regeneration, and — has its own materials requirements. Recent work on metal–organic frameworks (MOFs) demonstrates the potential and effectiveness of these materials in addressing this challenge. In this Review, we identify the specific structural and chemical properties of MOFs that have led to the highest capture capacities, the most efficient separations and regeneration processes, and the most effective catalytic conversions. The interior of the MOFs can be designed to have coordinatively

metal sites, specific heteroatoms, covalent functionalization, other building unit interactions, hydrophobicity, porosity, defects, and embedded nanoscale metal catalysts with a level of precision that is crucial for the development of higher-performance MOFs. To realize a total solution, it is necessary to use the precision of MOF chemistry to build more complex materials to address selectivity, capacity, and conversion together in one material.



### Welcome note by CENT director

On behalf of the Center of Excellence in NanoTechnology (CENT @ KFUPM), I would like to welcome you all to the new academic semester, and extend my sincere wishes for a successful and fruitful year . . . *Continued on page 2*

## NEW PATENTS



Two new US patents US 9662644 and US 20170198216 have been granted to researchers affiliated to the Center of Excellence in Nanotechnology . . {details on page 4}

## PROMOTIONS



CENT is pleased to announce the promotion of **Dr. Abbas Hakeem**, the Coordinator of the CENT Imaging Lab and **Dr. Muhammad Nahid Siddiqui** of the Chemistry Department to the rank of Full Professor. Details of their promotion can be found on page 4

## Welcome to the new academic year 2017/2018.

On behalf of the Center of Excellence in NanoTechnology (CENT @ KFUPM), I welcome you all to the new academic semester, and extend my sincere wishes for a successful and fruitful year.

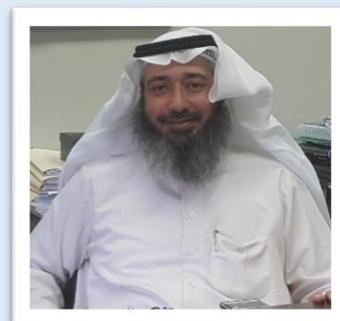
I seize this opportunity to reaffirm the Center's commitment and readiness to pursue its mission of providing the platform through which KFUPM shall develop a nanotechnology program that enables its scientists and faculty members to carry out world-class nanoscience-based research in areas of strategic importance for the Kingdom, and support the same through teaching at KFUPM.

CENT has become a fast-growing research center in the Kingdom and beyond. It hosts wonderful researchers who develop exotic nanomaterials, focused on applications in petroleum and petrochemicals. Annually, numerous CENT affiliated research articles are published in reputable and high impact factor journals including Chemical Reviews, Advanced Materials, ACS Nano and Nature, not to mention issuing several IP disclosures yearly.

Beyond research, Outreach and Education holds special attention at CENT. For example, last year we introduced the Lecture Series, an informative program where the Center's often used knowledge and techniques are discussed. This year, we bring back CENT'S students mentorship program (SMP), originally started in 2008, with a new look. The new SMP is aimed at training undergraduate students from science and engineering disciplines on several nanotechnology-related techniques, and to familiarize them with essential laboratory instrumentation. By the end of the 12-week program, the student is expected to have the ability to eventually run the laboratory equipment and to have learned the basic skills required to participate in CENT research work.

In this semester, you can look forward to a series of events which will include seminars and training workshops to be organized by the Center. We shall be keeping you posted as the events unfold through our website ([www.kfupm.edu.sa/cent](http://www.kfupm.edu.sa/cent)) or let us know if you would like to be added to the Friends of CENT mailing list, by e-mailing ([cent@kfupm.edu.sa](mailto:cent@kfupm.edu.sa)).

We look forward to working with you all to improve and continue to excel in nanotechnology-related research. On behalf of CENT, I wish you good health and great success.



**Dr. Zain Yamani**  
**CENT Director**

## Prof Yaghi research group published a high-profile review article in the prestigious *Nature Reviews Materials* journal on “The chemistry of metal–organic frameworks for CO<sub>2</sub> capture, regeneration and conversion”

Professor Omar M. Yaghi, the James and Neeltje Tretter Chair Professor of Chemistry at University of California, Berkeley, and the Saudi Aramco funded KFUPM Carbon Capture Chair, is the inventor of the largest class of materials ever realized. These materials, termed metal-organic frameworks (MOFs), are extended crystalline structures consisting of metal-based nodes (single ions or clusters) bridged by organic linking groups. They are far superior to other well-known porous materials, such as zeolites and carbon materials, because they couple high water, chemical, and thermal stability with ultrahigh porosity. From an application point of view, the fact that MOFs can be designed and synthesized for specific purposes, and that they have been proven scalable for widespread use in industrial settings, has attracted much interest from the (petro)chemicals, clean energy, environment, biotechnology, health, and water technology sectors, among others.

The discovery made by Prof. Yaghi, in 1998, set off a revolution in how materials are made, and captured the imagination of emerging scientists worldwide. Early in his career, Prof. Yaghi observed that emerging scientists were interested in making new MOFs, but they had no place to test their imagination and develop their dreams. As such, he later launched the Berkeley Global Science Institute, whose mission is to partner with universities around the world to create places of research. These ‘Global Science’ nodes would in turn provide opportunity for emerging scientists to carry out meaningful research. One such ‘Global Science’ node is at KFUPM.

Prof. Yaghi and his colleagues have published high profile discoveries (including in *Science* and *Nature* journals) in affiliation with KFUPM activities. Prof. Yaghi’s research at KFUPM continues to progress in a positive direction with the discovery and synthesis of several new MOF-related materials. Focus has turned to proper characterization and analysis of the materials’ carbon dioxide capture properties. The research team at KFUPM comprises two research scientists, two postdoctoral fellows, and three



Prof. Omar M. Yaghi with the Saudi Aramco-funded Carbon Capture Chair group at KFUPM

Ph.D. students from the Chemistry Department in addition to several affiliates from the KFUPM Research Institute and Chemistry Department. Frequent visits of UC Berkeley scholars have proven to be an integral part of the KFUPM Program, which is coordinated by Prof. Zain H. Yamani, KFUPM CENT Director.

This August, Prof. Yaghi led his KFUPM team (Prof. Zain H. Yamani, Dr. Aasif Helal, Dr. Bassem A. Al-Maythaly) and his UC Berkeley colleagues (Mr. Kyle E. Cordova, and Dr. Christopher A. Trickett) to publish a high-profile review

<http://www.nature.com/articles/natrevmats201745> in the prestigious *Nature Reviews Materials* journal, and their work was featured on the cover. In this publication, the team discussed the prospect of using MOFs to address all aspects of the carbon dioxide control cycle – from capture to regeneration and conversion. Specifically, the state-of-the-art performers were highlighted and specific structural features were discussed in the context of further optimizing and enhancing MOF function toward carbon dioxide. The team also elaborated on the challenges that the field of MOFs is currently facing and provided future directions that will inspire researchers from around the world to realize the consummate material that can be applied to the various components of the carbon dioxide control cycle. The Saudi Aramco support to KFUPM through the Strategic Research Partnership has enabled KFUPM to establish world class research programs on campus, and develop state of the art technologies in fields pertaining to the core business areas of the world’s leading oil company.

## RESEARCH CORNER

### US Patent No 20170198216

#### MONODISPERSED CARBOXYLATE FUNCTIONALIZED GOLD NANOPARTICLES AND THEIR SIZE CONTROLLED PREPARATION USING PAMOIC ACID AS A REDUCING AND CAPPING REAGENT

*Md. Abdul Aziz, Shaikh, M.N., Yamani, Z. H. A*

**Filing date:** Jan. 8, 2016

**Publication date:** July 13, 2017

#### **Abstract:**

Monodisperse carboxylate functionalized gold nanoparticles comprising a capping agent layer of pamoic acid and colloidal suspensions thereof are disclosed. These gold nanoparticles have an average particle size of greater than 15 nm or less than 8 nm and demonstrate significant fluorescent properties. In addition, a method for the size controlled preparation of these monodisperse carboxylate functionalized gold nanoparticles wherein pamoic acid acts as both a reducing and capping agent and wherein the size of the particles can be controlled by the pH of the process is disclosed. In addition, a method for the size controlled preparation of these monodisperse carboxylate functionalized gold nanoparticles utilizing seed mediated growth is disclosed.

### US PATENT, US 9662644

#### MAGNETIC CATALYST COMPOSITION FOR HYDROFORMYLATION OF OLEFINS

*Shaikh, M.N., Yamani, Z. H. A*

**Filing date:** September 30, 2016

**Publication date:** May 30, 2017

#### **Abstract:**

A functionalized nanomaterial having an average particles size of less than 10 nm comprising an iron oxide nanoparticle core and a bis(diarylphosphinomethyl) dopamine based ligand layer anchored to the iron oxide nanoparticle core is disclosed. In addition, a catalyst composition for use in a variety of chemical transformations wherein the bisphosphine groups of the functionalized nanomaterial chelate a catalytic metal is disclosed. In addition, a method for producing the functionalized nanomaterial and a method for the hydroformylation of olefins to aldehydes employing the functionalized nanomaterial with high conversion percentage and high selectivity are disclosed.

## PROMOTIONS



We are thrilled to announce the promotion of **Dr. Muhammad Nahid Siddiqui** of Chemistry Department to the rank of Full Professor. Dr. Siddiqui is a CENT affiliate and had published several CENT affiliated journal articles.

His promotion is a well-deserved achievement for which the entire staff of CENT congratulate him and wish him progress and development in his career and life.

Please join us in congratulating Dr. Siddiqui He can be reached via his email address [mnahid@kfupm.edu.sa](mailto:mnahid@kfupm.edu.sa)



CENT is pleased to announce the promotion of **Dr. Abbas Hakeem**, the Coordinator of CENT Imaging Lab, from Research Scientist-III to Research Scientist-II.

His promotion is a well-deserved and timely achievement for which the entire staff of CENT congratulate him and wish him progress and development in his career and life.

Please join us in congratulating Dr. Abbas, he can be reached via his email address [ashakeem@kfupm.edu.sa](mailto:ashakeem@kfupm.edu.sa)

## RECENT CENT AFFILIATED PUBLICATIONS

- "The chemistry of metal–organic frameworks for CO<sub>2</sub> capture, regeneration and conversion" **Christopher A. Trickett, Aasif Helal, Bassem A. Al-Maythaly, Zain H. Yamani, Kyle E. Cordova & Omar M. Yaghi**, *Nature Reviews Materials* 2, Article number: 17045 (2017).
- "Confinement of Mn<sup>3+</sup> redox sites in Mn-KIT-6 and its catalytic activity for styrene epoxidation," **N. Anbazhagan, G. Imran, A. Qurashi, A. Pandurangan and S. Manimaran**, *Microporous and Mesoporous Materials*, Vol. 247, issue, 2017, pp 190-197.
- "Recent progress in layered double hydroxides (LDH)-containing hybrids as adsorbents for water remediation," **M. Zubair, M. Daud, G. McKay, F. Shehzad and M. A. Al-Harhi**, *Applied Clay Science*, Vol. 143, issue, 2017, pp 279-292.
- "A Simple and Direct Preparation of a Substrate-Free Interconnected Nanostructured Carbon Electrode from Date Palm Leaflets for Detecting Hydroquinone," **M. Aziz, D. Theleritis, M. O. Al-Shehri, M. I. Ahmed, M. Qamaruddin, A. S. Hakeem, A. Helal and M. A. A. Qasem**, *ChemistrySelect*, Vol. 2, issue 17, 2017, pp 4787-4793.
- "Mechanochemical Route and Recrystallization Strategy To Fabricate Mordenite Nanoparticles from Natural Zeolites," **T. Kurniawan, O. Muraza, A. S. Hakeem and A. M. Al-Amer**, *Crystal Growth & Design*, Vol. 17, issue 6, 2017, pp 3313-3320.
- "Enhancement of Thermoelectric Behavior of La<sub>0.5</sub>Co<sub>4</sub>Sb<sub>12-x</sub>Te<sub>x</sub> Skutterudite Materials," **S. M. Said, M. B. A. Bashir, M. F. M. Sabri, Y. Miyazaki, D. A. A. Shnawah, A. S. Hakeem, M. Shimada, A. I. Bakare, N. N. N. Ghazali and M. H. Elsheikh**, *Metallurgical and Materials Transactions A*, Vol. 48, issue 6, 2017, pp 3073-3081.
- "Synthesis and characterization of functionalized polythiophene for polymer-sensitized solar cell," **M. N. Siddiqui, M. Mansha, U. Mehmood, N. Ullah, A. F. Al-Betar and A. A. Al-Saadi**, *Dyes and Pigments*, Vol. 141, issue, 2017, pp 406-412
- "Mixed-Metal Metal–Organic Frameworks as Catalysts for Liquid-Phase Oxidation of Toluene and Cycloalkanes," **A. M. P. Peedikakkal, A. A. Jimoh, M. N. Shaikh and B. E. Ali**, *Arabian Journal for Science and Engineering*, Vol. 42, issue 10, 2017, pp 4383-4390
- "MB-UiO-66-NH<sub>2</sub> Metal-Organic Framework as Chromogenic and Fluorogenic Sensor for Hydrazine Hydrate in Aqueous Solution," **A. Helal, M. Qamaruddin, M. A. Aziz, M. N. Shaikh and Z. H. Yamani**, *ChemistrySelect*, Vol. 2, issue 25, 2017, pp 7630-7636.
- "Highly selective fluorescent probe for sequential recognition of copper (II) and iodide ions," **H. Seo, M. An, B.-Y. Kim, J.-H. Choi, A. Helal and H.-S. Kim**, *Tetrahedron*, Vol. 73, issue 31, 2017, pp 4684-4691