DOI 10.1515/gps-2013-0020 — Green Process Synth 2013; 2: 175–177

Organization profile

Khalid M. Abu-Salah, Mansour Alhoshan, Mohammed Zourob* and Abdullah M. Azzeer

King Saud University: nanoscience and nanotechnology research highlights

***Corresponding author: Mohammed Zourob**, King Abdullah Institute for Nanotechnology, King Saud University, P.O. Box 2454, 11451 Riyadh, Saudi Arabia, e-mail: nanoksu@ksu.edu.sa
Khalid M. Abu-Salah, Mansour Alhoshan and Abdullah M. Azzeer: King Abdullah Institute for Nanotechnology, King Saud University, P.O. Box 2454, 11451 Riyadh, Saudi Arabia

Introduction

King Saud University (KSU) is the oldest and largest university in the Kingdom of Saudi Arabia (Figure 1) [1]. It was established in the year 1957. Students began studying in the College of Arts in the 1957–58 academic years. Since that time, KSU has gone through many stages of developments, and its administrative organization has developed and adapted according to the diverse needs and expanding role of the nation [2]. A great many changes had taken place in the years after that, such as the establishing of new colleges and opening of new branches throughout the Kingdom. Between 1958 and 1960, three colleges were established: the College of Sciences, the College of Business (now the College of Public Administration) and the College of Pharmacy [2]. Currently there are 25 colleges, 4 academic and research institutes, 12 deanships, 15 research centers, more than 100 research chairs and 37,874 students of both sexes [1–2]. The university offers courses in the natural sciences, the humanities, and professional studies, for which it charges no tuition. The medium of instruction in undergraduate programs is English except for Arabic and Islamic subjects [3].

Vision and mission

To be a world-class university and a leader in developing Saudi Arabia's knowledge society [2].

To provide students with a quality education, conduct valuable research, serve the national and international societies and contribute to Saudi Arabia's knowledge society through learning, creativity, the use of current and developing technologies and effective international partnership [2].

Infrastructure

KSU is one of the leading Gulf Corporation Council (GCC) Universities in nanotechnology that has excellent infrastructure and facilities. King Abdullah Institute for Nanotechnology (KAIN) (http://nano.ksu.edu.sa/) was established in 2008 with the mission of developing a professional research workplace for the fields of nanoscience and nanotechnology. KAIN houses now a state-of-the-art infrastructure, with different research groups working on research problems of high national demands. KAIN researchers belong to different multidisciplinary backgrounds, and they have professional and internationally recognized profiles in their fields [4].

The infrastructure in KAIN consists of central facilities that serve all researchers, and specialized group laboratories for specific applications (Figure 2). Below is a short profile on the research themes, facilities and research groups at King Abdullah Institute for Nanotechnology [4].

Figure 1 King Saud University [2].

Figure 2 KAIN Building (under construction) [4].

Research themes

According to the strategic 5-year plan, the research focus has been set in KAIN for energy, water and bionanotechnology issues, where KAIN is advancing in the research contribution to these major national concerns [4].

Central research facilities (core lab facilities):

a. Electron Microscopy Unit: This unit serves the researchers in the institute (as well as KSU staff and many industrial collaborators) to analyze their samples using different electron microscopy techniques. The unit contains a field-emission scanning electron microscope with EDX detector, backscattering detector, and with a metal coating unit for nonconducting samples. The unit also includes a transmission electron microscope (FE gun, 200 keV), that has EDX and STEM attachments. TEM sample preparation by FIB and ion slicer is also available.
b. Analytical Unit: houses many techniques for the characterization of optical, structural, electrical, thermal and morphological properties of nanomaterials. The unit includes the following techniques: AFM, XRD (with specialized attachments for thin films and SAXS), Micro-PL, Micro-Raman, FTIR, UV-Vis-NIR transmittance/absorbance/reflectance, Particle size analyzer, differential thermal analyzer, surface area and porosity measurement setup, and AC/DC electrical measurements at cryo temperatures.
c. Clean Room Unit: includes equipment for the full process of microfabrication by UV lithography, PECVD coating system for solar cell applications, with other equipments on their way to be installed (EBL and others).

KAIN will move to its 8000 square meter facilities as soon as the new building (under construction) is completed. Research space and facilities are expected to expand and will allow more researchers to join in (Figure 3).

Research groups

Currently several research groups at KAIN and other university colleges such as Science; Engineering & Health are actively involved in research [4].

1. Multifunctional Nanomaterials Group: Researchers in this group have intense experience in the controlled synthesis of nanomaterials for specific applications. Tailoring the different physical properties and controlling the size and morphology of nanomaterials is being carried out in our labs at international levels.

Figure 3 King Abdulla Institute for Nanotechnology Labs [4].

Many research projects are being conducted by this group, including for example:

a. Development of magnetic core nonconducting shell nanomaterials for drug delivery.
b. Development of smart hydrogel nanomaterials with high thermal response to human body temperature.
c. Development of smart nanomaterials for biosensing, labeling and medical imaging applications.
d. Development of novel catalyst/electrode distribution for fuel cells.
e. Development of nanomaterials with active crystalline facets for dye-sensitized solar cells.

2. Solar Cells Group: Researchers in this group work on sensitized solar cells where our labs house the spectrum of all equipment needed to fabricate a laboratory testing cell and measure the cell efficiency. The lab also includes methods for charge dynamical studies of solar cells (IPCE, EIS, IMPS, IMVS, Laser flash photolysis). A PECVD system is being installed and tested for a-Si solar cell applications.
3. Water Membrane Group: The water membrane laboratory includes facilities and equipment for all fabrication and testing processes of flat sheet as well as hollow fiber water membranes. Equipment for morphology, mechanical, thermal and chemical measurements on membranes are available (AFM, TOC, AAS, Tensile machine, TGA, UV-Vis etc). The group is working on the improvement of water membranes by the controlled treatment of these membranes using nanomaterials. The aim is to produce water membranes with high and stable throughput, with increased lifetime and to overcome some technological problems such as anti-fouling etc.
4. Ultrafast Photonics Group: This newly established group is mainly concerned at the time-resolved characterization of complex systems in the femtosecond and attosecond time range. Advanced ultrafast techniques are being built in our labs to study the time evolution of basic and fundamental processes taking place in complex systems such ionized gases, solar cells, and biological systems.
5. Theoretical Group: Researchers in this group are focusing on the mathematical modeling and theoretical studies of different physical properties of nanomaterials, which are of great usefulness to experimentalists. The group is also working on the invention of new nanotechnological laser systems studying the limitations and chances for experimentalists to realize them.

The research activities of the above research groups culminated in publishing more than 40 research papers (in 2012 only) in highly reputable peer reviewed journals and filing 2 patents [4].

International collaboration and partnerships

To enrich the academic community at KSU and to enhance research international collaboration and partnership, KAIN signed several national and international memoranda of understanding (MOUs). These include MOUs with Max-Planck Institute of Quantum Optics (Germany), University of Illinois at Urbana Champaign (USA), THALES (France), Leeds University (UK), Stockholm University (Sweden), University Sains Malaysia and Chinese National Academy of Science (China) [4].

KAIN hosted several international workshops and conferences to which distinguished and internationally renowned scholars were invited.

Visiting professors from all over the world are hosted regularly by KAIN. The visits consist besides giving scientific talks, discussion sessions with faculty members and researchers in the field of nanotechnology and other interrelated disciplines. The feasibility of carrying out joint research projects is considered as well.

References

[1] "Top Universities". Top Universities. 2009-11-12. http://www.topuniversities.com/institution/king-saud-university. Retrieved 2010-11-16.
[2] http://ksu.edu.sa/AboutKSU/Pages/History1.aspx.
[3] http://en.wikipedia.org/wiki/King_Saud_University.
[4] http://nano.ksu.edu.sa/