المملكة العربية السعودية
الخطة الوطنية للعلوم والتقنية والابتكار

Full Research Proposal
Application Form

PLAN	PROGRAM	CODE / NUMBER
The First Five-Year STI Plan	**STRATEGIC TECHNOLOGIES Research Program**	**STRP-11**
	SUB-PROGRAM / TECHNOLOGY AREA	
	Energy	
	TRACK	
	Electricity Distribution and Transmission	
	SUB-TRACK	
	Collecting and recycling of electromagnetic radiation	
Proposal Title English	**Design and Development of Energy Harvesting Devices for Wireless Power Transmission**	**ENE2018**
Proposal Title Arabic	تصميم وتطوير اجهزة حصاد الطاقة لانتاج ونقل الطاقة لاسلكيا	
P. Investigator English	**El-Sayed Ibrahim El-Sayed Emam Shalaan**	
P. Investigator Arabic	**السيد ابراهيم السيد امام شعلان**	
Institution	**Faculty: Science** **Department: Physics** **King Abdulaziz University**	

SUBMITTED FOR THE DEADLINE ON	☐ 30th MARCH	■ 30th SEPTEMBER	**FOR GS-CNPESTI USE ONLY**
DATE RECIEVED			

CNPSTI Form RE-D1

PROJECT INFORMATION

Project Title	**Design and Development of Energy Harvesting Devices for Wireless Power Transmission**
Technology Area	**Energy**
Track	**Electricity Distribution and Transmission**
Sub-Track	**Collecting and recycling of electromagnetic radiation**
Project Type	
Proposed Total Budget	**1685300 Saudi Riyals**
Estimated Duration	(24) **Months**
Proposed Starting Date	**Month / Year**

Research Team

No.	**Name**	**Research Status**	**Role**	**Area of Specialization**
Senior Personnel				
1	**EL-Sayed Shalaan**	**Assistant Professor**	**P I**	**Engineering of Material Sciences**
2	**Fahd Al-Marzouki**	**Professor**	CO- I.1	**Nano-Device physics**
3	**Ahmed Al-Ghamdi**	**Professor**	CO- I.2	**Applied Physics**
4	**Ali Zain AL-Zahrani**	**Assistant Professor**	CO- I.3	**Solid State Physics**
5	**Abdullah Ali Al-Shaikhi**	**Assistant Professor**	CO- I.4	**Solid State Physics**
Other Personnel				
6	**Will be selected**		Postdoctoral Associate	
7	**Will be selected**	**1**	Ph.D. Student	
8	**Will be selected**	**3**	M.S. Student	
9	**Will be selected**	**1**	Technician	
10			Project Manager	
11			Other	
Consultant				
12	**Prof. Dong S. Ha** **Bradley Dept. of Electrical and Computer Engineering, Virginia Tech**		**Country: USA**	

Keywords (max. 4)	**1. Wireless Power Transmission**	**2. Energy Harvesting**
	3. Nanodevice	**4. Sensors**
Is this Proposal being submitted to any other funding institution ?	☐ **Yes, Specify**	**1.** **2.** **3.**
	☒ **No**	

CNPSTI Form RE -D1-1

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- **Cover Sheet for Proposal** (Form RE-D1)
- **Project Information** (Form RE -D1-1)
- **Summary (English):**

We propose to help solve the energy problems by directly harvesting (collecting and recycling) emitted energies from infrared/electromagnetic radiation sources that are available in our daily use. The proposed device receives the electromagnetic radiation, rectifies, and converts it to direct current which can then be stored or used for satisfying electrical energy needs. At the end of this four-phase program, our main goal is to develop an energy collector/recycling device that harness significant amounts of electromagnetic energy for supplying electrical power to the communities without involving wires.

- **Summary (Arabic):**

نهدف من هذا البحث المشاركه فى وضع بعض الحلول لمواجهه مشاكل الطاقة المختلفة والمحافظة على بيئة نظيفة عن طريق تصميم وتطوير اجهزة حصاد الطاقة (تجميع واعادة تدوير الطاقة) من خلال الموجات الكهرومغناطيسية كموجات الراديو الموجوده حولنا والمنتشرة فى كل مكان. الجهاز المقترح هنا يقوم باستقبال الموجات الكهرومغناطيسية وتقويمها وتحويلها الى تيار كهربى يمكن الاستفادة منه لحظيا او تخزينة لاستفادة منه عند الحاجة . نأمل عند نهاية هذا البحث النجاح فى صناعة اجهزة حصاد الطاقة التى تقوم بتخزين وانتاج الطاقة من الموجات الكهرومغناطيسية المنتشرة حولنا لامداد المجتمع بطاقة كهربية لاسلكيه نظيفة.

1. INTRODUCTION

All kinds of electronic devices and applications, from small watches, laptops, mobile phones, power tools, satellites, hybrid cars up to uninterruptible power supplies (UPS), required an external electrical power sources or batteries. Unfortunately, cables, connectors and chargers are often a source of error. Moreover, charger and connectors are not always compatible with different terminal devices, so that each device type needs its own custom-tailored connector and battery charging solution.

Energy Harvesting is the process of capturing minute amounts of energy from one or more of naturally-occurring energy sources, accumulating and storing them for later use. Common sources of energy harvesting are:

- Mechanical Energy - from sources such as vibration, mechanical stress and strain,
- Thermal Energy - waste energy from furnaces, heaters, and friction sources,
- Light Energy - captured from sunlight or room light via photo sensors, photo diodes, or solar panels,
- Electromagnetic Energy - from inductors, coils and transformers,
- Ambient Energy - from the environment such as wind, water flow, ocean currents, and solar,
- Human Body - a combination of mechanical and thermal energy naturally generated from bio-organisms or through actions such as walking and sitting,
- Other Energy - from chemical and biological sources,

Energy-harvesting devices efficiently and effectively capture, accumulate, store, condition and manage this energy and supply it in a form that can be used to perform a helpful task. Similarly, an Energy harvesting module is an electronic device that can perform all these functions to power a variety of sensor and control circuitry for intermittent duty applications. It is important to note that all these energy sources are virtually unlimited and essentially free, if they can be captured at or near the system location.

The work here is motivated by two types of applications: (1) wireless powering of sensor and (2) RF/EM energy recycling being aware of the energy consumption and effect to the natural environment. For purposes of discussion it will be desirable to handle these two objectives separately:

Wireless powering of sensor

The combination of extremely low-power microprocessors and improvement of communication protocols and power supply technologies, increasingly affordable supercapacitors for energy storage and budding more energy efficient and monitor inventory has enabled a new generation of energy-recycling devices. Typically, wireless sensors are designed to observe environments in a more flexible way than wired ones; for example, can-tracking status of oil well in the middle of a field, generating early warnings of impending earthquakes, and assessing the structural health of bridges. But sensor's power supply is the most confounding problem. In solving this problem, the recycling of emitted energy from strategically placed transmitters or from the ambient energy emitted by cell-phone towers and television stations is the best promising solution.

RF/EM energy recycling

The use of normal batteries has two disadvantages: (1) the lifetime of the batteries is very limited even for low-power batteries, requiring impractical periodical battery replacement, and (2) the use of commercial batteries usually overkills the power requirements for μW sensor nodes, adding size and weight while creating the problem of environmental pollution due to the deposition of these batteries, as well as increases significantly the cost overhead of disposable nodes; "being green" is becoming a big requirement in these days; new information and communication technology should be conscious of the energy consumption and effect to the natural environment; in this way solar cells, the most common energy-harvesting technique, can’t soak up photons from inside applications and will be major obstacles for the quick penetration of ubiquitous network services. A really emerging area is getting hybrid power supplies

(RF/EM energy recycling) and might finally make the devices truly independent. Finally, with significantly more flexible sensors installations, new promising applications will be created.

2. PROJECT OBJECTIVES

At the end of this four-phase program, our main goal is to develop an energy collector/recycling device that harness significant amounts of electromagnetic energy for supplying electrical power to the communities without involving wires.

The overall objectives of the present proposal can be summarized as follows:

1) Development of fabrication process of small-scale energy harvesting module.
2) Selection of suitable materials for fabrication; explore the relevant material and fabrication parameters.
3) Testing and Characterization of the energy harvesting circuit/module.
4) Embedded the module into real device/application, eg. sensors

3. LITERATURE REVIEW

Although there is a considerable body of research into energy harvesting technology and many hundreds of published papers, this is a rapidly growing area with many recent developments [1-3]. Traditional battery-powered system works under limited energy supply. For applications that require long working duration, energy becomes a critical bottleneck and much effort has been devoted to energy efficient or low-power system design [4-8]. With advances in micro-electromechanical (MEMS) technology, it is possible to implement a self-powered system that harvests ambient energy from the environment [6, 9-12]. Several different ambient sources have been exploited, including thermal gradients [13-29], solar power [30-33], ambient RF [34-36], human bodily fluids [37], flow of gasses [38,39] and mechanical piezoelectric vibration [40-46]. The advantages and disadvantages of each type of energy harvesting are discussed thoroughly in [47-53] and consequently the arguments will not be repeated here.

Such energy harvesting system provides a promising alternative to battery-powered system and creates an opportunity for architecture and design method innovation for the exploitation of ambient energy source. The design criteria for systems in using an energy harvesting source are fundamentally different from that in using a battery. The battery-based system benefits from a relatively predictable metric of energy residual, suffices to characterize the energy availability, and is seemingly an unbounded power supply. Traditional low-power system design aims to minimize the average power dissipation in order to increase the power-up duration of the device. For energy harvesting systems, rather than a limited energy supply, it has a limit on the power at which the energy can be used. Also, the harvested energy supply from the ambient sources is stochastic in nature and, thus, a more sophisticated characterization and design metric are required for the energy harvesting circuits.

Several key issues were addressed before embarking upon designing the indoor energy harvesting device. Firstly, RF/EM energy has to be harvested by an efficient energy system, and secondly, there has to be an efficient means of storing this harvested energy. The system must also effectively deliver the stored energy to the preferred device. This means there has to be an intelligent power management strategy in place. Obviously, this strategy must not be power hungry and should serve to lengthen the life of the energy storage devices. These details along with design considerations that impact efficiency and the associated tradeoffs are the main issue to be covered in this work.

For some ubiquitous applications, the average power consumption can be down to the level of tens to hundreds of micro watts. In this case, energy harvested from environments can be used as an alternative power source to provide a virtually infinite lifetime. Mechanical energy conversion is one of the common sources for these energy harvesting applications. Low level vibrations commonly occur in household or industrial environments. It is estimated that mechanical vibrations inherent in the environment can provide a power density of tens to hundreds of micro watt per cm^3, which is sufficient to sustain operations of a sensor node, Table 1.

In 2011, there will be 150 million to 200 million wireless sensors being used in factory automation, process and environmental control, security, medicine, and condition-based maintenance, as well as in defence application and intelligence gathering. Such wireless sensor systems will require numerous individual devices (nodes/motes) to provide comprehensive monitoring capability; be located in inaccessible places much of the time; and have to operate with long intervals between scheduled maintenance. Periodic maintenance, such as replacing batteries, would clearly increase operating costs, and could be inconvenient, at best, if it required interruption of a continuous process. Therefore, there is clearly a need to develop a micro energy source that can last years with little or no maintenance.

Table 1: Different energy sources with harvested power.

Energy Source		Harvested Power
Vibration/Motion	Human	4 μW/cm2
	Industry	100 μW/cm2
Temperature Difference	Human	25 μW/cm2
	Industry	1-10 mW/cm2
Light	Indoor	10 μW/cm2
	Outdoor	10 mW/cm2
RF	GSM	0.1 μW/cm2
	WiFi	0.001 μW/cm2

Advanced technical developments have increased the efficiency of devices in capturing trace amounts of energy from the environment and transforming them into electrical energy. In addition, advancements in microprocessor technology have increased power efficiency, effectively reducing power consumption requirements. In combination, these developments have sparked interest in the engineering community to develop more and more applications that utilize energy harvesting for power.

4. DESCRIPTION OF THE PROPOSED WORK

4.1 Approach, tasks and phases:

APPROACH UTILIZED FOR ACHIEVING OBJECTIVES

Objective	Approach of achieving the objective
Development of fabrication process of small-scale energy harvesting module.	**A primary focus of this effort will be to evaluate energy harvesting as an alternative to batteries for powering a nano-devices and sensors. This will be done by:** **Review available energy harvesting technologies in scientific literature and those sold as commercial products. Concentrate on harvesting technologies may include, but are not limited to, electromagnetic, electrostatic, and thermoelectric devices. Storage technologies may include, but are not limited to, batteries, capacitors, and supercapacitors.**
Selection of suitable materials for fabrication; explore the relevant material and fabrication parameters.	**Once an energy harvesting technology and compatible energy storage technology have been selected, we will mate these with investigating energy-harvester-aware design methods. It will radically advance the state-of-the-art in ultra low power design and expand it into the area of power-adaptive electronic and computing.**
Testing and Characterization of the energy harvesting circuit/module	**We plan to test the performance of the energy accumulator, rectifying antenna and related circuitry.**
Embedded the module into real device/application, eg. sensors	**Design of a new sensor board and integrating the energy harvesting module/circuit and testing the functionality and circuit behaviour.**

MAPPING OF PHASES AND TASKS TO ACHIEVE OBJECTIVES

Objectives	Phases	Tasks
Development of fabrication process of small-scale energy harvesting module.	**Phase 1: State of the Art Specifications and Requirements**	**Task 1.1: State of the art survey. This task will provide a thorough state-of-the-art on energy harvesting techniques. Task 1.2: Definition of the applicability and use cases as will as specification and requirements. This task will provide a detailed in terms of technological challenges, desirable functionalities and practical constraints.**
Selection of suitable materials for fabrication; explore the relevant material and fabrication parameters.	**Phase 2: Investigation and Design**	**Task 2.1: Development of energy harvester based on the survey performed in Phase 1, we plan to focus our developments on electromagnetic harvesting techniques by designing state of the art antennas. Task 2.2: Development of a modular energy accumulator. This task will deal with the development of a secondary power source, which can collect extra energy obtained from the harvesting solution. For example, Lithium Sulfur Cells and super capacitors, or their combination, will be studied. Task 2.3: Reference architecture design. This task is in charge of ensuring the coherence of the whole sensor platform. It will receive as input all the innovations provided by other Phase 2 tasks and will provide as output the requirements needed for all the innovations to work together.**
Testing and Characterization of the energy harvesting circuit/module	**Phase 3: Validation and Integration**	**Task 3.1: Harvesting testing and characterization. In this task we plan to test the performance of the energy accumulator, rectifying antenna and related circuitry. Task 3.2 Modules Integration. This task, starting from the reference architecture defined by Task 2.3, will study the integration of the developed modules in order to provide inputs to the final implementation that will be carried out in Phase 4.**
Embedded the module into real device/application, eg. sensors	**Phase 4: Implementation**	**Task 4.1: Implementation Task. The main output of this task will be the design of a new sensor board, integrating the solutions proposed in Phase 2, considering the results obtained by Phase 3. Task 4.2: Testing Task. The objective of this task is that of testing the developed prototype in some realistic applications.**

Form RE -D1-3

4.2 Research methodology

This work interested in current approaches of using energy extracted from the environment to power microelectronic devices. The electrical energy to power the electronics is generated from electromagnetic radiation. The obtained energy can then be used to recharge a secondary battery or, in some cases, to power directly the electronics. The output voltage and current of the generators is transient and discontinuous in nature, and must be converted to a DC signal. Therefore it is necessary to design a converter and/or storage circuit that needs to take into account the output signal of the generator and its impedance.

Many challenges exist that make effective energy harvesting a difficult goal. How can the energy-harvesting machinery fit on the extremely small devices use in for example in sensors? How can energy-harvesting technology be simplified to produce the maximum power with minimal consumption? The major broad challenges for energy harvesting can be summarized as:

- Engineering small harvesters that nonetheless collect sufficient energy.
- For advanced sensoring equipment, more power may be required, resulting in a potential trade-off between energy and sensoring tools.
- Storing the energy requires space, conflicting with our desire for small devices.

Several key points have to be taken into account to achieve a design of this kind of system. First, it is possible to increase the generated energy using new transducer designs or new materials, as well as innovative power conditioning circuits and energy storage elements. Second, current portable electronic devices have different low power or sleep modes to save energy during times of inactivity. The management of these modes is very important in relation with an energy harvesting strategy, allowing to "refill" the energy reservoir of the system during these periods of low activity. This means that generally, a discontinuous operation use model is mandatory for the energy harvesting approach. Finally, consumption reduction by specified static and dynamic architecture and regulation between load and source will introduce the need of energy optimization.

4.3 Management Plan,

ROLE AND INVOLVEMENT DURATION OF RESEARCH TEAM

Team Members	Role	Duration (months)
Senior Personnel:		
PI. **El-Sayed Shalaan**	• **Approves Plan and Schedule** • **Ensuring the project's overall objectives, targets at various key stages, and individuals' responsibilities are clearly understood by all concerned;** • **Ensures project makes good use of assets** • **Maintains project focus on its goal and outcomes** • **Supervise and provide technical direction to team members** • **Review all team deliverables** • **Hold regular team status meetings** • **Ensuring that the project proceeds according to the agreed plan** • **Monitoring performance against the plan;** • **Highlighting areas of slippage and identifying/initiating corrective action;** • **Completing the project reports;** • **Ensuring that the project complies with all appropriate University procedures and regulations, e.g. human resources, financial and procurement etc**	**20**
CO-I.1 **Fahad Al-Marzouki**	• **Responsible of device/circuit design;** • **Responsible for Phase 2 and Phase 3**	**20**
CO-I.2 **Ahmed Al-Ghamdi**	• **Responsible for Phase 2 and Phase 4**	**20**
CO-I.3 **Ali Zain AL-Zahrani**	• **Responsible for Phase 1 and Phase 4**	**10**
CO-I.4 **Abdullah Ali Al-Shaikhi**	• **Responsible for Phase 1 and Phase 3**	**10**
Other Personnel:		
Consultant: **Dong S. Ha**	**The consultant utilizes experienced professionals to:** • **Diagnose problems** • **Recommend optimum solutions** • **Aid in implementation activities** • **Discussing and analysis the results**	**20**

Form RE -D1-4

WORK PLAN AND TIME SCHEDULE

PHASES & TASKS	Duration Involvement	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
PHASE I: State of the Art Specifications and Requirements	Participation																								
Task 1.1: State of the art survey. This task will provide a thorough state-of-the-art on energy harvesting techniques.	PI, CO-I.3, CO-I.4, Consultant	■	■																						
Task 1.2: Definition of the applicability and use cases as will as specification and requirements. This task will provide a detailed in terms of technological challenges, desirable functionalities and practical constraints.	PI, CO-I.3, CO-I.4, Consultant		■	■	■																				
PHASE 2: Investigation and Design																									
Task 2.1: Development of energy harvester based on the survey performed in Phase 1, we plan to focus our developments on electromagnetic harvesting techniques by designing state of the art antennas.	PI, CO-I.1, CO-I.2, CO-I.3, Consultant					■	■	■	■	■															
Task 2.2: Development of a modular energy accumulator. This task will deal with the development of a secondary power source, which can collect extra energy obtained from the harvesting solution. For example, Lithium Sulfur Cells and super capacitors, or their combination, will be studied.	PI, CO-I.1, CO-I.2, CO-I.3, Consultant						■	■	■	■	■														
Task 2.3: Reference architecture design. This task is in charge of ensuring the coherence of the whole sensor platform. It will receive as input all the innovations provided by other Phase 2 tasks and will provide as output the requirements needed for all the innovations to work together.	PI, CO-I.1, CO-I.2, CO-I.4, Consultant							■	■	■	■	■	■												
PHASE 3: Validation and Integration																									
Task 3.1: Harvesting testing and characterization. In this task we plan to test the performance of the energy accumulator, rectifying antenna and related circuitry.	PI, CO-I.1, CO-I.4 Consultant													■	■	■	■	■							
Task 3.2: Modules Integration. This task, starting from the reference architecture defined	PI, CO-I.1, CO-I.4 Consultant														■	■	■	■	■						

by Task 2.3, will study the integration of the developed modules in order to provide inputs to the final implementation that will be carried out in Phase 4.																									
PHASE 4: Implementation																									
Task 4.1: **Implementation Task. The main output of this task will be the design of a new sensor board, integrating the solutions proposed in Phase 2, considering the results obtained by Phase 3.**	**PI, CO-I.2, CO-I.2 Consultant**																								
Task 4.2: **Testing Task. The objective of this task is that of testing the developed prototype in some realistic applications.**	**PI, CO-I.2, CO-I.3 Consultant**																								

Form RE- D1-5

PI: El-Sayed Shalaan**;** **CO-I.1:** Fahd Al-Marzouki**;** **CO-I.2:** Ahmed Al-Ghamdi**;** **CO-I.3:** Ali Zain AL-Zahrani**;** **CO-I.3:** Abdullah Ali Al-Shaikhi
Consultant: Dong S. Ha

4.4 Project Deliverables:

RELATIONSHIP TO STRATEGIC FRAMEWORK

PROJECT EXPECTED OUTCOMES	STRATEGIC TECHNOLOGY PROGRAM GOALS				PROJECT OBJECTIVE ACHIEVED
	Efficiently exploiting national energy resources	**Supporting national self dependence in critical energy technologies**	**Supporting the local energy industry to attain development and growth with technology solutions that facilitate new product development, improve production efficiency, environmental protection, etc…**	**Developing innovative technologies for special needs that cannot be satisfied efficiently or economically through existing systems.**	
Development of fabrication process of small-scale device	For adapting and developing energy technologies through promoting an effective research and development culture, formulating comprehensive and competitive solutions, and developing expert human resources				Education of young people. Create new basic and applied scientific knowledge
Selection of suitable materials for fabrication	Optimal utilization of available resources and preserve the environment.				Create new applied scientific knowledge
Testing and Characterization of the device Embedded the module into real device/application, eg. sensors	Transferring some energy technologies		Possibility to reduce electricity generation costs.	Support the national economy and sustained national development	Develop and commercialize products and processes resulting from the program

Form RE- D1-6

5. VALUE TO THE KINGDOM

The use of wireless-power devices offers several advantages over existing, wired methodologies. Factors include flexibility, ease of implementation and the ability to facilitate the placement of sensors in previously inaccessible locations. The ability to retrofit systems without having to consider issues such as cabling, offers a significant advantage in applications for areas such as condition-based monitoring (CBM), where embedded wireless micro-sensors can provide continuous monitoring of machine and structural health without the expense and inconvenience of including wiring looms. The wires (and associated connectors) are often a source of failure in such systems and present a considerable cost issue.

Generally, the benefit of wireless power devices can be classified to:

A. Industrial: Minimizes Operating Costs

- Eliminates cost to hard wire or replace batteries – e.g. wireless sensors
- Eliminates service downtime caused by depleted batteries
- Reduces battery handling and disposal

B. OEMs: Improved Product Design

- Sealed devices – less expensive enclosures and manufacturing
- Embedded power – eliminate wires, cables, connectors
- Reliability – improved durability, reduced product failures, eliminate ESD

C. End-Users: Convenience and Usability

- Placement flexibility – no charging mats or charging stations
- Transparent charging – no user action required
- Embedded power – eliminate wires, cables, connectors

<u>Additionally the following are the benefit of this research proposal especially for the kingdom:</u>

1. Expanded international collaboration, including cooperation between Saudi universities (KAU) and world universities (USA).
2. Create new basic and applied scientific knowledge
3. Support the national economy and sustained national development by recycling the electromagnetic radiation.
4. Reduce electricity generation costs and save environment through use of electromagnetic radiation (renewable energy).
5. Develop and commercialize products and processes resulting from this program.

6. PROJECT EXECUTION

6.1 Current Resources:

The physic department contains state-of-the arts equipments and instruments including:

1. Sputtering system (RF and DC)
2. Electron beam gun
3. Thermal evaporation system
4. Plasma enhanced chemical vapour deposition for synthesis of carbon nanotubes
5. Elepsometry
6. UV-Vis spectrophotometer
7. Many instruments for electrical characterization
8. Advanced furnaces
9. Low temperature electrical system (below to 4 K)

The following instruments arrived and will be installed:

1. Electron beam lithography
2. Atomic force microscope
3. Hi-TEM
4. FTIR
5. Raman spectroscopy

6.2 Requested Resources:

Human resources: (See Form RE-D1-7)

Equipments: The required list of equipment may include the following:

1. Nanogenerator
2. Plasma cleaner SBT-150
3. Air table and linear motor.

4. Electric Characterization Platform: The required platform can perform electric characterization with through multiple channels at high precision and high speed (current and voltage as low as 1pA and 1 μ V)
5. High frequency electrical testing system: The E5071B network analyzer offers fast and accurate measurements for RF components. The Agilent E5262A lowers cost-of-test by providing a high-speed parametric test solution for semiconductor, RFIC, and optical component testing needs. The Agilent HP 8648B, Synthesized Signal Generator (DC- 9kHz to 2000MHz), that is ideal for manufacturing high-volume products such as cordless telephones, pagers and two-way radios with a range of 9kHz to 2000MHz.
6. Holding frame and interface for nandevices: Nanodevices are manipulated and connected within a Faraday Cage

Materials and consumables: For arranged the lab, manufacturing and testing the devise we need some material and consumables. (See Form RE-D1-7 for budget)

Transportation facilities and travel arrangements: To execute the project, the PI may needs to travel to USA for discussion and do some experiments. Also the consultant will visit Saudi Arabia several times. Also we need to attend some of workshops and conferences. (See Form RE-D1-7 for budget)

6.3 Proposed Budget:

SEE INSTRUCTIONS BEFORE COMPLETING

SUMMARY
PROPOSED BUDGET

(in Saudi Riyals)

ITEM	CATEGORY	NO.	COMPENSATION	FIRST YEAR MONTHS	FIRST YEAR BUDGET	SECOND YEAR MONTHS	SECOND YEAR BUDGET	TOTAL
PROJECT TITLE								
DURATION	(24) MONTHS							
MANPOWER	CONSULTANTS							
	PRINCIPAL INVESTIGATOR	1	6000	10	60000	10	60000	120000
	CO-INVESTIGATOR	4	5000	30	150000	30	150000	300000
	OTHER SENIOR PERSONNEL							
	POSTDOCTORAL ASSOCIATE							
	RESEARCH ASSTISTATS :-							
	PHD STUDENTS	1	2500	4	10000	4	1000	20000
	MS STUDENTS	3	2000	18	36000	18	36000	72000
	UNDERGRADUATE STUDENTS							
	PROJECT MANAGER							
	TECHNICIANS	1	1600	4	6400	4	6400	9200
	SECRETARIAL- CLERICAL							
	OTHER							
SUMMER COMPENS.	COMPENSATION 1							
	COMPENSATION 2							
TOTAL SALARIES (INCLUDING SUMMER COMPENSATION)								564800
EQUIP. & MATERIAL	MSJOR EQUIPMENTS (> = 100.000)			400000		100000		500000
	EQUIPMENTS (< 100,000)							
	MATERIALS & SUPPLIES			300000		100000		400000
ITEM TOTAL								900000
TRAVEL	CONFERENCES			15000		15000		30000
	TRAINING							
	FIELD TRIPS							
	TICKETS			15000		15000		30000
ITEM TOTAL								60000
OTHERS	PATENT REGISTRATION							
	PUBLICATIONS			5000		10000		15000
	WORKSHOP			15000		15000		30000
	OTHER EXPENSES			57750		57750		115500
ITEM TOTAL								160500
GRAND TOTAL								1685300

SALARIES (INCLUDING SUMMER COMPENSATION)	%	34.23
EQUIPMENTS & MATERIALS	%	54.55
TRAVEL	%	3.64
OTHERS	%	7.58
GRAND TOTAL	100 %	100

FORM RE- D1-7

6.4 Budget Justification:

For manpower section:

- The allowances of investigators are according to rules
- Allowances for PhD, Master(s), and technician will be given for doing help during research work, where they will design the electric circuits and different experiments that will be used.

For equipments and materials:

- This work required a lot of equipments for building self-powered nanodevices and embedded it into a real application/sensor. All the requested instruments will be needed to carry out the experiments nicely, the require instruments are:
    1. Nanogenerator
    2. Plasma cleaner SBT-150
    3. Air table and linear motor.
    4. Electric Characterization Platform: The required platform can perform electric characterization with through multiple channels at high precision and high speed (current and voltage as low as 1pA and 1 μ V)
    5. High frequency electrical testing system: The E5071B network analyzer offers fast and accurate measurements for RF components. The Agilent E5262A lowers cost-of-test by providing a high-speed parametric test solution for semiconductor, RFIC, and optical component testing needs. The Agilent HP 8648B, Synthesized Signal Generator (DC-9kHz to 2000MHz), that is ideal for manufacturing high-volume products such as cordless telephones, pagers and two-way radios with a range of 9kHz to 2000MHz.
    6. Holding frame and interface for nandevices: Nanodevices are manipulated and connected within a Faraday Cage
- In addition, for the design and manufacturing of the device special material and consumables are required.

For travel and others:

- Frequent visits will be needed to carry out some experiments and test the device. Results will be presented at various conferences.
- Consultant’s visit would be needed for smooth flow of the project work.
- This grant will be utilized to purchase papers, photocopying, tracing, publication charges and registration fee of the conference and workshops also for some sample measurements, HRTEM, EDX and SAED, etc..

8. UNDERTAKING OF THE RESEARCH TEAM: (Form RE -D1-8)

UNDERTAKING OF THE RESEARCH TEAM

The research team undertakes that:

1- **The text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision.**

2- **No part of this proposal has been funded by any other source.**

3- **No existing funds are available to the research being proposed from any other source.**

4- **No fund would be sought from any other source if an award is made as a result of this proposal.**

5- **We agree to accept responsibility for the scientific conduct of this project.**

ROLE	INVESTIGATOR NAME	SIGNATURE
Principal Investigator	**EL-Sayed Shalaan**	
CO- PI. 1	**Fahad Al-Marzouki**	
CO- PI. 2	**Ahmed Al-Ghamdi**	
CO- PI. 3	**Ali Zain AL-Zahrani**	
CO- PI. 4	**Abdullah Ali Al-Shaikhi**	
CO- PI. 5		

Form RE- D1-8

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10. RESUMES:

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Research highlites	The Keywords of my research are: Nanophysics; Nanotechnology; Material Science and nanodevices; Solid State Physics; Computational Physics

Fuded Projects	▪ Principle investigator, Nanopowders: Engineered materials (2010/2011). King Abdulaziz University, Saudi Arabia. (completed) ▪ Principle investigator, Synthesis and Characterization of Some Nonporous Materials (2010). King Abdulaziz University, Saudi Arabia. (completed)
Patents	

List of Publications

Some selected papers:

1. E. Shalaan, A. Al-Ghamdi, F. Al-Marzouki and S. Yaghmour. New synthesis method of sponge-like SiC nanoporous thin film from a preceramic polymeric based on poly(methylsilyne) as the SiC precursor. Submitted to Mesoporous and microporous.
2. E. Shalaan, A. Al-Ghamdi, F. Al-Marzouki and S. Yaghmour. Synthesis of SiC nanoporous membrane using ion track etching technique. Submitted to Material Characterization.
3. E. Shalaan, A. A. Al-Ghamdi, S. Yaghmour, T. Al-Harby, F. El-Tantawy, Spectroscopic Ellipsometry Study of Nanocrystalline Ga2O3 Thin Film, Submitted to Material letter.
4. S. A. Mansour, M. E. Al-ghoury, E. Shalaan, M. H. I. El Eraki and E. M. Abdel-Bary, Dielectric dispersion and AC conductivity of acrylonitrile butadiene rubber-poly(vinyl chloride)/graphite composite, Journal of Applied Polymer Science, Volume 122, Issue 2, 15 October 2011, Pages: 1226–1235.
5. E. Shalaan, A. A. Al-Ghamdi, S. Al-Henity, F. Al-Marzouki, F. El-Tantawy, Synthesis of ultrafine β-Ga2O3 nanopowder via hydrothermal approach: A strong UV ”excimer-like” emisión, Materials Letters, Volume 65, Issue 2, 31 January 2011, Pages 317-321
6. E. Shalaan, H. Schmitt, A. Al-Ghamdi, Amorphous GdN buffer-layer-enhanced switching properties of Gd switchable mirrors, Solid State Sciences, Solid State Sciences, Volume 12, Issue 12, December 2010, Pages 2130-2133
7. E. Shalaan, A.A. Al-Ghamdi, Ag enhances optical and switching properties of gadolinium hydride films, Journal of Alloys and Compounds, Volume 504, Issue 1, 13 August 2010, Pages 233-236
8. S. A. Mansour, M. E. Al-Ghoury, E. Shalaan, M. H. I. El Eraki and E. M. Abdel-Bary, Electrical properties and transport conduction mechanism of nitrile rubber/poly(vinyl chloride) blend, Journal of Applied Polymer Science, Volume 116, Issue 6, 15 June 2010, Pages: 3134–3139 .
9. S. A. Mansour, M. E. Al-Ghoury, E. Shalaan, M. H. I. El Eraki and E. M. Abdel-Bary, Thermal properties of graphite-loaded nitrile rubber/poly(vinyl chloride) blends, Journal of Applied Polymer Science, Volume 116, Issue 6, 15 June 2010, Pages: 3171–3177 .
10. M. Abu-Assy, E. Shalaan, A. Abdelaziz, Effect of lattice thermal vibrations on dechanneling of positrons in disorder cubic metals, Arab. J. Nuc. Sci. & Applic. Vol 42 (2010) n2.
11. E. Shalaan, H. Schmitt, Urbach tail of gadolinium trihydride films. Journal of Materials Science 42 (2007) 3255-3258.
12. E. Shalaan, K. –H Ehses, H. Schmitt, In-situ x-ray-diffraction studies of hydrogenated nanocrystalline gadolinium films. Journal of Materials Science 41 (2006) 454
13. E. Shalaan, H. Schmitt, Mg nanoparticle switchable mirror films with improved absorption–desorption kinetics, Surface Science, Volume 600, Issue 18, 15 September 2006, Pages 3650-3653
14. E. Shalaan, H. Schmitt, Structural and optical properties of sputtered gadolinium nitride films, Optics Communications, Volume 260, Issue 2, 15 April 2006, Pages 588-594
15. H. Schmitt, E. Shalaan,Optical and Electrical Switching Properties of Gadolinium - Gadolinium Hydride / Palladium Silver System, In Nanoporous and Nanostructured Materials for Catalysis, Sensor, and Gas Separation Applications, edited by Lu, S. W., Hahn, H., Weissmuller, J., and Gole, J. L. (Mater. Res. Soc.Symp. Proc. 876E, Warrendale, PA), R8.56 (2005.(
16. E. Shalaan, H. Schmitt, K.-H. Ehses, On the optical properties of gadolinium hydride systems, Thin Solid Films, Volume 489, Issues 1-2, 1 October 2005, Pages 330-335

B) Published contributions to academic conferences

1. H. Schmitt, E. Shalaan (2005): Optical and Electrical Switching Properties of Gadolinium - Gadolinium Hydride / Palladium Silver System, In Nanoporous and Nanostructured Materials for Catalysis, Sensor, and Gas Separation Applications, edited by Lu, S. W., Hahn, H., Weissmuller, J., and Gole, J. L. (Mater. Res. Soc.Symp. Proc. 876E, Warrendale, PA), R8.56.
2. E. Shalaan, H. Schmitt (2005): Mg nanoparticle switchable mirror films with improved absorption-desorption kinetics. In proceeding of ECOSS 23 – European Conference on Surface Science, Berlin, Germany.
3. E. Shalaan, H. Schmitt, K. –H Ehses (2004): On the physical properties of gadolinium hydride systems. In proceeding of the 5th International Conference on Coatings on Glass, Saarbrcken, Germany.

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List of Publications

Year 2011

- K. Zeng, J. Yun, D.S. Ha, and D.J. Inman, "Wireless Low-Power Structural Health Monitoring System for Wind Turbine Blades", *to appear in 2011 World Congress on Advances in Structural Engineering and Mechanics (ASEM11+),* September 2011.
- N. Kong, T.S. Deyerle, and D.S. Ha, "Universal Power Management IC for Small-Scale Energy Harvesting with Adaptive Impedance Matching", *to appear in Energy Conversion Congress and Exposition (ECCE)*, September 2011.
- R. Thirugnanam and D.S. Ha, "Feasibility Study for Communication over Power Distribution Networks of Microprocessors", *to appear in IEEE International SOC Conference*, September 2011.
- T.L. Cochran, J.K. Kim, and D.S. Ha, "Low Power Wake-Up Receiver With Unique Node Addressing", *to appear in IEEE International Midwest Symposium on Circuits and Systems (MWSCAS),* August 2011.
- Y. Shim, S. Yuwono, S.-J. Kim, J.-M. Kim, S.-K. Han, S.-G. Lee, and D. S. Ha, "A 520 pJ/pulse IR-UWB Radar for Short Range Object Detection", *IEEE RFIC Symposium*, RMO2A-4 (4 pages), June 2011
- V. Chawla and D.S. Ha, "Dual Use of Power Lines for Data Communications in Microprocessors" *IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems*, pp. 23-28, April 2011.
- J.K. Kim, J. Jeong, D.S. Ha, and H-S Lee, "Low-Power Quadrature VCO Design for Medical Implant Communication Service" *IEEE Symposium on Design and Diagnostics of Electronic Circuits and Systems (DDECS),* pp. 403-404, April 2011.
- J.K. Kim, J. Jeong, D.S. Ha, and H-S Lee, "A Current-Reuse Quadrature VCO for Wireless Body Area Networks" *IEEE-NIH Life Science Systems and Application Workshop (LiSSAâ□™11),* pp. 55-58, April 2011.
- J. Jeong, J.K. Kim, D.S. Ha, and H-S Lee, "A Reliable Ultra Low Power Merged LNA and Mixer Design for Medical Implant Communication Services" *IEEE-NIH Life Science Systems and Application Workshop (LiSSAâ□™11),* pp.51-54, April 2011.
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- J. Yun, D.S. Ha, D.J. Inman, and R. Owen, "Adverse Event Detection (AED) System for Continuously Monitoring and Evaluating Structural Health Status" *SPIE International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring*, Vol. 7977, 79771R-1, (11 pages), March 2011.

Year 2010

- S. Park, S.R. Anton, J.K. Kim, D.J. Inman, and D.S. Ha, "Instantaneous Baseline Structural Damage Detection using a Miniaturized Piezoelectric Guided Waves System", *Korean Society of Civil Engineers (KSCE) Journal of Civil Engineering*, vol. 14, no. 6, pp. 889-895, November 2010.
- J.Y. Oh, J.K. Kim, H.-S. Lee. S.-S. Choi, and D.S. Ha, "Phase Rotation Shift Keying for Low Power and High Performance WBAN In-body systems", *IEEE International Conference on Information and Communication Technology Convergence (ICTC),* , pp. 28-32, November 2010.
- D. Zhou, D.S. Ha, and D.J. Inman, "Ultra Low-Power Active Wireless Sensor for Structural Health Monitoring, *International Journal of Smart Structures and Systems*, Vol. 6, No. 5-6, pp. 675-687, July/August, 2010.
- N. Kong, D.S. Ha, A. Erturk, and D.J. Inman, "Resistive Impedance Matching Circuit for Piezoelectric Energy Harvesting,"*Journal of Intelligent Material Systems and Structures*, Vol. 21, No. 13, pp. 1293 â□“ 1302, September, 2010. (Online version: http://jim.sagepub.com/cgi/rapidpdf/1045389X09357971v1).
- S. Deyerle, D.S. Ha, and D.J. Inman, "A Low-Power System Design for Lamb Wave Methods,"*SPIE International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring*, Vol. 7650,765019-1 (7 pages), March 2010.
- D. Zhou, N. Kong, D.S. Ha, and D.J. Inman, "A Self-powered Wireless Sensor Node for Structural Health Monitoring," *SPIE International Symposium on Smart Structures and Materials & Nondestructive Evaluation and Health Monitoring*, Vol.7650, 765010-1, (12 pages), March 2010.
- N. Kong, T. Cochran, D.S. Ha, H.-C. Lin, D.J. Inman, "A Self-powered Power Management Circuit for Energy Harvested by a Piezoelectric Cantilever," *Applied Power Electronics Conference and Exposition*, pp. 2154 -2160, February 2010.
- H. Zhai, S. Sha, V.K. Shenoy, S. Jung, M. Lu, K. Min, S. Lee, and D.S. Ha, "An Electronic Circuit System for Time-Reversal of Ultra-Wideband Short Impulses based on Frequency Domain Approach," *IEEE Transactions on Microwave Theory and Techniques*, Vol. 58, No. 1, pp.74-86, January 2010.

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Nationality	Date of Birth	Country of Birth
Saudi	1954	Saudi Arabia

Highest Degree	University	Date of Graduation
PhD	Kent university, England	1988

Academic Title	Major field	Specialization
Professor	Physics	Electronics

Scientific Profile (Please describe briefly in 5 lines maximum)	- Solid state electronics Devices and applications - Super conductors - Semiconductors - Thin films
Qualifications (Please describe briefly in 5 lines maximum)	- B.Sc in physics, K.A.U.,SA, 1979. - M.Sc in physics, Tulane university, USA, 1982. - PhD. In electronics, Kent university, England, 1988.
Research highlites	I am mostly interested in the electronic properties of systems in reduced dimensions. I seek for novel ways of exploring topics of fundamental and applied physics based on innovative devices or innovative implementations of known devices. My research program is articulated around two different themes of research: Theme 1: Multifunctional devices Theme 2: Advanced nanofabrication
Fuded Projects	
Patents	

List of Publications

1. R. J. BENNET, A. VRADIS., AND F. AL-MARZOUKI "TECHNIQUES OF SIS JUNCTIONS" THE THIRD SYMPOSIUM IN SOLID STATE PHYSICS, GREECE, pp 168-170, 1987.
2. F. AL-MARZOUKI AND A. VRADIS " MODELLING AND CHARACTERIZATION OF ALL Nb (SIS) JUNCTION " THE FOURTH SYMPOSIUM IN SOLID STATE PHYSICS, GREECE, 1988.
3. F. ALMARZOUKI AND M. MARZOUK, " ANALYSIS & PERFOMANE OF NOVEL RECTANGULAR & SINUSOIDAL Oscill " IEEE, ISOCS, Vol. 5 pp 1585-1588 U.S.A, 1991.
4. A. EL-HENNAWY AND F. AL-MARZOUKI, " A PRECIES MOS – IC PEFRANCE VOLTAGE REGULATOR FOR 12 BIT DAC APPLICATIONS" AIN SHAMS UNIV. ENG. BULLETIN. Vol. 26 NO:3, pp 246-269, CAIRO,EGYPT,1991.
5. M. A. NASSEF , M. SOBHY , F. AL-MARZOUKI, AND A. NAZIR "THE DESIGN AND SIMULATION OF DIODE AND MOSFET MICROWAVE MIXER CIRCUITS, JNRCC 1991 D10 , (1-8) , CAIRO, EGYPT,1991.
6. A. EL-HENAWY AND F. AL-MARZOUKI, " DESIGN AND SIMULATION OF A MONO-CHANNEL, SINGLE MOSFET NON-VOLATILE EEPROM MEMORY CELL COMPATIBLE WITH SCALING-DOWN TREND " . AIN SHAMS UNIV. ENG. BULLETIN, Vol. 26, No:3, pp 222-245, CAIRO, EGYPT, 1991.
7. A. EL-HENNAWY, F. AL-MARZOUKI AND S. AL-GHAMDI, " MODELLING AND CHAR OF NEW NEGATIVE RESISTANCE NR-MOSFET FPR VLST APPLICATIONS ICM, pp 349-392, CAIRO, EGYPT, 1991.
8. A. EL-HENAWY AND F. AL-MARZOUKI, STUDY AND CHARACTERIZATION OF MOSFET INTEGRATED MAGNETODETECTOR BASED ON " HOT CARRIER DETECTION " IEE Vol. 139, pp 119-125 U.K, 1992.
9. F. AL-MARZOUKI, PREPARATION OF ALL Nb – SIS JUNCTION USING A NOVEL E-Beam SOURCE ET- AL-ICCMPA. 13th – 16th APRIL, 1992.
10. A. AL-HENNAWY, F. AL-MARZOUKI AND S. AL-GHAMDI, " A NEW MOSFET IC LASER DRIVE WITH ON-CHIP THERMAL AND OPTICAL STABILIZATION " 18th INTERNATIONAL Conf. FOR SCSSDR, CAIRO, EGYPET. 1993.
11. F. AL-MARZOUKI, ETAL " PREPARATION AND PROPERTIES OF Nb THIN FILMS " J.K.A.N. Sci Vol. 5, pp 99-106, 1993. K.S.A.
12. A. EL-HENNAWY AND F. AL-MARZOUKI, STUDY AND CHARACTERIZATION OF NEW " MOSFET LASER SOURCE " 18th INT. CONFERENCE FOR, SCSSDR, CAIRO, EGYPT, pp 13, 1993.
13. F. AL-MARZOUKI, ADEL EL-HENNAWY AND SAID AL-GHAMDI " STUDY AND CHARACTERIZATION OF A NEW TRAPEZODAL CHANNEL MOSFET FOR NEGATIVE RESISTANCE APPLICATIONS " K.A. JOURNAL OF SCIENCE Vol. 8, pp 55-66,1996.
14. ADEL EL-HENNAWY, F. AL-MARZOUKI AND SAID AL-GHAMDI " STUDY AND CHARACTERIZATION OF NEW MOSFET LASER SOURCE " THE FIRST INTERNATIONAL CONFERENCE FOR MATERIAL SCIENCE, MU'TAH UNIVERSITY, JORDAN, 1-4/11/1997.
15. F. ALMARZOUKI, ADEL EL-HENNAWY, SAID AL-GHAMDI AND S. S. AL-AMEER " A NEW MOSFET IC LASER-DRIVER WITH ON- CHIP THERMAL AND OPTICAL STABILIZATION " ARAB GULF JOURNAL SCIENCE RES. 16(3), pp.519-535 (1998).
16. F. AL-MARZOUKI, ADEL E. EL-HENNAWY, SAID A. AL-GHAMDI " STUDY AND REALIZATION OF A NEW NEGATIVE RESISTANCE USING MOSFET TECHNOLOGY " KAR. U. JOURNAL OF SCIENCE, Vol. 26(2), pp 17-24, 1998.
17. SALAH H. JAMAL AND F. AL-MARZOUKI " ASSESSMENT OF APPROXIMATE BALANCE EQUATION TRANSPORT MODELS USED FOR SUBMICRON SILICON DEVIVE MODELLING " INTERNATIONAL JOUR. OF ELECTRONICS, Vol. 86, No:8, pp 919-928, 1998.
18. S. S. AL-AMEER AND F. AL-MARZOUKI " I-V CHARACTERISTICS OF III – V COMPOUNDS GaAs FOR MOSFET DEVICES, J. OF K.A.U, Vol. 10, pp 77-87, 1998.
19. AZHAR AHMED ANSARI AND F. AL-MARZOUKI " ELECTRICAL CONDUCTION IN POLYIMIDE FILMS " INDIA JOURNAL OF PHYSICS, 73A (6), pp1-4, 1999.
20. F. AL-MARZOUKI, " PREPARATION AND STUDY OF SIS JUNCTION BY E-BEAM SOURCE " OXFORD R. F. JOURNAL Vol. 1, No:1,pp 15-20, 1999.
21. F. AL-MARZOUKI, " MODELLING AND SIMULATION OF NEW MOSFET NEGATIVE RESISTANCE FOR VLSI APPLICATIONS " INDIAN JOURNAL OF PURE AND APPLIED PHYSICS, Vol. 37, pp 490-494, 1999.
22. F. AL-MARZOUKI, " NUMERICAL STUDIES OF ALL Nb SIS TUNNEL JUNCTION " ARABIAN JOU. FOR SCIENCE AND ENGINEERING Vol. 24, No: 2 A, pp 1-8, 1999.
23. F. AL-MARZOUKI, AZHAR A. ANSARI AND HAIFAA M. A. AL-TOUMAH " TERMPERATURE DEPENDENCE OF SCHOTTKY BARRIERS IN EPITAXIALLY GROWN Ga As DIODES " OXFORD R.F. JOURNAL, Vol. 1, No: 2, pp 31-34, 2000.
24. F. ALMARZOUKI " SIMS ANALYSIS STUDY OF THE ALL Nb SIS JUNCTION " JOURNAL OF K.A.U SCIENCE, Vol. 13,pp 99-109, 2001.
25. A. A. ANSARI, F. AL-AMRZOKI AND H. M. AL-TOUMAH " EFFECT OF DEEP TRAPS AN C-V. MEASUREMENTS ON EPITAXIALLY GROWN Ga As SCHOTTKY DIODES. K. A. JOURNAL OF SCIENCE Vol. 29, pp 3-9, 2001.

C.V. of CO-I.2

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Institute / University (Work) **King Abdulaziz Uinversity**	College/ Directorate Science	Department Physics
Nationality **Saudi**	Date of Birth 1959	Country of Birth Saudi Arabia
Highest Degree **PhD**	University Sussex University, Flamer, Brighton, UK	Date of Graduation 1989
Academic Title **Assistant Professor**	Major field Physics	Specialization Solid State Physics

Scientific Profile (Please describe briefly in 5 lines maximum)	- Preparation of nanomaterials and nanocomposits and their physical characterizations - Point defects in crystals and their investigations
Qualifications (Please describe briefly in 5 lines maximum)	- PhD in Physics (1989), (Ion Implantation & Point Defect in solid); Department of Physics, Sussex University, Flamer, Brighton, UK . - M.Sc. in Physics (1984); Department of Physics, Tulane University, New Orleans, Missouri, USA - B.Sc. in Physics (1980); Department of Physics, King Abdulaziz University, Jeddah, Saudi Arabia
Research highlites	- Optical properties of amorphous nanomaterials - Electrical properties of nanomaterials - Effect of non ionizing irradiations on biological systems - Devices and applications
Fuded Projects	- Completed 3 two-year projects from KACST (3.2 million riyals) competed on 2005, 2007, 2010. - Completed around 20 university small projects around 50000 SR each. - Currently working in approved national project in nanotechnology in Strategic Project program (1.8 million SR). - Currently working in an international research collaborative program supported by the higher education (20 million SR). - Currently submitted two chairs project at the university in sensors (a waiting for fund). - Currently applied in conjunction with some international and European group a project for support to the European Union (1 million euro) (not yet approved).
Patents	5 USA patents in pending state

List of Publications

1. Zishan H. Khan, Numan Salah, Sami Habib, A.A. Al-Ghamdi, Shamshad A. Khan, Electrical and optical properties of a-SexTe100–x thin films,Optics & Laser Technology, Volume 44, Issue 1, February 2012, Pages 6-11
2. M.A. Alvi, Shamshad A. Khan, A.A. Al-Ghamdi, Photo-induced effects on electrical properties of Ga15Se81Ag4 chalcogenide thin films, Materials Letters, Volume 66, Issue 1, 1 January 2012, Pages 273-275
3. Reem M Al-Tuwirqi, A.A. Al-Ghamdi, Faten Al-Hazmi, Fowzia Alnowaiser, Attieh A. Al-Ghamdi, Nadia Abdel Aal, Farid El-Tantawy, Synthesis and Physical Properties of Mixed Co3O4/CoO Nanorods by Microwave Hydrothermal Technique, Superlattices and Microstructures, In Press, Accepted Manuscript, Available online 17 September 2011
4. A.A. El-Daly, Farid El-Tantawy, A.E. Hammad, M.S. Gaafar, E.H. El-Mossalamy, A.A. Al-Ghamdi, Structural and elastic properties of eutectic Sn–Cu lead-free solder alloy containing small amount of Ag and In, Journal of Alloys and Compounds, Volume 509, Issue 26, 30 June 2011, Pages 7238-7246
5. A.A. Al-Ghamdi, Shamshad A. Khan, S. Al-Heniti, F.A. Al-Agel, M. Zulfequar, Annealing and laser irradiation effects on optical constants of Ga15Se85 and Ga15Se83In2 chalcogenide thin films, Current Applied Physics, Volume 11, Issue 3, May 2011, Pages 315-320
6. A.A. El-Sebaii, S. Al-Heniti, F. Al-Agel, A.A. Al-Ghamdi, F. Al-Marzouki, One thousand thermal cycles of magnesium chloride hexahydrate as a promising PCM for indoor solar cooking, Energy Conversion and Management, Volume 52, Issue 4, April 2011, Pages 1771-1777
7. Reem Al-Tuwirqi, A.A. Al-Ghamdi, Nadia Abdel Aal, Ahmad Umar, Waleed E. Mahmoud, Facile synthesis and optical properties of Co3O4 nanostructures by the microwave route, Superlattices and Microstructures, Volume 49, Issue 4, April 2011, Pages 416-421.
8. A.A. Al-Ghamdi, M.A. Alvi, Shamshad A. Khan, Non-isothermal crystallization kinetic study on Ga15Se85−xAgx chalcogenide glasses by using differential scanning calorimetry, Journal of Alloys and Compounds, Volume 509, Issue 5, 3 February 2011, Pages 2087-2093
9. A.A. Al Ghamdi, A.T. Nagat, F.S. Bahabri, R.H. Al Orainy, S.E. Al Garni, Study of the switching phenomena of TlGaS2 single crystals, Applied Surface Science, Volume 257, Issue 8, 1 February 2011, Pages 3205-3210
10. E.I. EL-Sayed, A.A. Al-Ghamdi, S. Al-Heniti, F. Al-Marzouki, F. El-Tantawy, Synthesis of ultrafine β-Ga2O3 nanopowder via hydrothermal approach: A strong UV "excimer-like" emission, Materials Letters, Volume 65, Issue 2, 31 January 2011, Pages 317-321
11. E. Shalaan, H. Schmitt, A.A. Al-Ghamdi, Amorphous GdN buffer-layer-enhanced switching properties of Gd switchable mirrors, Solid State Sciences, Volume 12, Issue 12, December 2010, Pages 2130-2133
12. A.A. Al-Ghamdi, Farid El-Tantawy, New electromagnetic wave shielding effectiveness at microwave frequency of polyvinyl chloride reinforced graphite/copper nanoparticles, Composites Part A: Applied Science and Manufacturing, Volume 41, Issue 11, November 2010, Pages 1693-1701
13. A.A. Al-Ghamdi, Shamshad A. Khan, A. Nagat, M.S. Abd El-Sadek, Synthesis and optical characterization of nanocrystalline CdTe thin films, Optics & Laser Technology, Volume 42, Issue 8, November 2010, Pages 1181-1186
14. Waleed E. Mahmoud, A.A. Al-Ghamdi, Synthesis of CdZnO thin film as a potential candidate for optical switches, Optics & Laser Technology, Volume 42, Issue 7, October 2010, Pages 1134-1138
15. A.A. Al-Ghamdi, Shamshad A. Khan, S. Al-Heniti, F.A. Al-Agel, T. Al-Harbi, M. Zulfequar, Effects of laser irradiation on optical properties of amorphous and annealed Ga15Se81In4 and Ga15Se79In6 chalcogenide thin films, Journal of Alloys and Compounds, Volume 505, Issue 1, 27 August 2010, Pages 229-234
16. Shamshad A. Khan, Zishan H. Khan, A.A. El-Sebaii, F.M. Al-Marzouki, A.A. Al-Ghamdi, Structural, optical and electrical properties of cadmium-doped lead chalcogenide (PbSe) thin films, Physica B: Condensed Matter, Volume 405, Issue 16, 15 August 2010, Pages 3384-3390
17. E. Shalaan, A.A. Al-Ghamdi, Ag enhances optical and switching properties of gadolinium hydride films, Journal of Alloys and Compounds, Volume 504, Issue 1, 13 August 2010, Pages 233-236
18. Shamshad A. Khan, J.K. Lal, A.A. Al-Ghamdi, Thermal annealing effect of on optical constants of vacuum evaporated Se75S25−xCdx chalcogenide thin films, Optics & Laser Technology, Volume 42, Issue 5, July 2010, Pages 839-844
19. Shamshad A. Khan, F.A. Al-Agel, A.S. Faidah, S.J. Yaghmour, A.A. Al-Ghamdi, Characterization of Se88Te12 nanostructured chalcogenide prepared by ball milling, Materials Letters, Volume 64, Issue 12, 30 June 2010, Pages 1391-1393
20. Shamshad A. Khan, F.A. Al-Agel, A.A. Al-Ghamdi, Optical characterization of nanocrystalline image and image chalcogenides, Superlattices and Microstructures, Volume 47, Issue 6, June 2010, Pages 695-704
21. Anis Ahmad, Shamshad A. Khan, A.A. Al-Ghamdi, Faisal A. Al-Agel, Kirti Sinha, M. Zulfequar, M. Husain, Kinetics of non-isothermal crystallization of ternary Se80Te20−xZnx glasses, Journal of Alloys and Compounds, Volume 497, Issues 1-2, 14 May 2010, Pages 215-220
22. Waleed E. Mahmoud, A.A. Al-Ghamdi, S. Al-Heniti, S. Al-Ameer, The influence of temperature on the structure of Cd-doped ZnO nanopowders, Journal of Alloys and Compounds, Volume 491, Issues 1-2, 18 February 2010, Pages 742-746
23. A.A. El-Sebaii, F.S. Al-Hazmi, A.A. Al-Ghamdi, S.J. Yaghmour, Global, direct and diffuse solar radiation on horizontal and tilted surfaces in Jeddah, Saudi Arabia, Applied Energy, Volume 87, Issue 2, February 2010, Pages 568-576
24. Shamshad A. Khan, F.S. Al-Hazmi, S. Al-Heniti, A.S. Faidah, A.A. Al-Ghamdi, Effect of cadmium addition on the optical constants of thermally evaporated amorphous Se–S–Cd thin films, Current Applied Physics, Volume 10, Issue 1, January 2010.

C.V. of CO-I.3

Name (English)	Ali Zain Hamed AlZahrani		
E-mail	azalzahrani@kau.edu.sa		
Country **Saudi Arabia**	City Jeddah	Postal Code 21589	P.O. Box 80203
Mobil No. **0558378456**	Telephone No. (Office) 64125	Telephone No. (Home) 0558378456	Fax No. 6952287

Institute / University (Work) **King Abdulaziz Uinversity**	College/ Directorate Science	Department Physics
Nationality **Saudi**	Date of Birth August 1980	Country of Birth Suadi Arabia
Highest Degree **PhD**	University School of Physics at the University of Exeter, U.K	Date of Graduation 2009
Academic Title **Assistant Professor**	Major field Physics	Specialization Solid State Physics

Scientific Profile (Please describe briefly in 5 lines maximum)	▪ 2003-2004: Scientific researcher in the Institute of Atomic Energy Research at King Abdulaziz City for Science and Technology (KACST)-Riyadh. ▪ 2004-20010: Instructor in the Department of Physics at King Abdulaziz University-Jeddah. ▪ 2010-Present: Assistant professor in the Department of Physics at King Abdulaziz University- Jeddah.
Qualifications (Please describe briefly in 5 lines maximum)	▪ 1999-2003: B.Sc. in Physics from King Abdulaziz University (KAU)-Jeddah. ▪ 2004-2006: M.Sc. in Physics from King Abdulaziz University (KAU) -Jeddah. ▪ 2007-2009: Ph.D from the School of Physics at the University of Exeter, U.K.
Research highlites	▪ Solid State Physics. ▪ Quantum Physics and Quantum Mechanics. ▪ Surface Physics and Material science. ▪ Mathematical and Computational Physics.
Fuded Projects	1. Theoretical investigation of manganese adsorption on graphene and graphane: A first-principles comparative study (General Project- 66/432), A. Z. AlZahrani (Principle Investigator) and K. A. Siddiqui (Co-investigator) accepted to be funded by the Deanship of the Scientific Research (2010). 2. Structural, electronic, and optical properties of Ce-doped fullerene: Density functional and group theory investigations (General Project- 23/432), A. Z. AlZahrani (Principle Investigator) K. A. Siddiqui (Co-investigator) accepted to be funded by the Deanship of the Scientific Research (2010).
Patents	

List of Publications

1. A. Z. AlZahrani and G. P. Srivastava, Formation of atomic gold chain on a Si(110) surface: A density functional investigation, Journal of Applied Physics (submitted).
2. A. Z. AlZahrani and D. Usanmaz, Progressive changes in surface structure and electronic properties on Si(001) surface by CaF2 adsorption, Journal of Applied Physics (accepted).
3. A. Z. AlZahrani, Ab initio calculations of surface structure and electronic properties caused by adsorption of Ca atoms on a Si(110) surface, Physica B, 406, 1909 (2011).
4. A. Z. AlZahrani, Theoretical investigation of atomic structure and electronic properties of Ca/Si(110)-(2×1) reconstruction Thin Solid Films (accepted).
5. A. Z. AlZahrani and G. P. Srivastava, First-principles investigations of low-coverage Ca-induced reconstructions on the Si(001) surfaceSurface Science 605, 101 (2011).
6. O. H. Mobarek and A. Z. AlZahrani, A Z-Dependent Variational Solution of Thomas-Fermi-Dirac Equation, International Journal of Mathematical Modelling and Numerical Optimization, 2, 69 (2011).
7. A. Z. AlZahrani and G. P. Srivastava, Structural and Electronic Properties of H-Passivated Graphene, Appl. Surf. Sci. 256, 5783 (2010).
8. A. Z. AlZahrani, First-principles study on structural and electronic properties of graphene upon adsorption of benzene and naphthalene, Appl. Surf. Sci. 257, 807 (2010).
9. A. Z. AlZahrani, Density functional calculations for Manganese impurity in Silicon material, Physica B: Condens. Matter 405, 4195 (2010).
10. A. Z. AlZahrani , K. A. Siddiqui, and F. S. AlHazmi, A Molecular Theoretic Approach to GaN, International Journal of Nano & Biomaterials, 2, 425 (2009).
11. A. Z. AlZahrani and G. P. Srivastava, Self-assembled Bi nanolines on the InAs(100) surface: a theoretical study International Journal of Nano & Biomaterials 2, 155 (2009).
12. A. Z. AlZahrani and G. P. Srivastava, A comparative study of clean and Bi-induced (2×4) reconstruction on theInP(001) surface Phys. Rev. B 79, 125309 (2009).
13. A. Z. AlZahrani and G. P. Srivastava, Gradual changes in the electronic properties from graphene to graphite first-principles calculations, J. Phys.: Condens. Matter 21, 495503 (2009).
14. , A. Z. AlZahrani and G. P. Srivastava, Graphene to graphite: electronic changes within DFT calculationsBraz. J. Phys. 39, 4 (2009).
15. A. Z. AlZahrani, G. P. Srivastava, R. Garg and M. A. Migliorato, An ab initio study of electronic and structural properties of Mn in GaAs environment, J. Phys.: Condens. Matter 21, 485504 (2009).
16. M. Shimomura, T. K. Kawaguchi, Y. Fukuda, K. Murakami, A. Z. AlZahrani and G. P. Srivastava, Bidentate chemisorption of acetic acid on a Si(001)-(2x1) surface: Experimental and theoretical investigations Phys. Rev. B 80, 165324 (2009).
17. A. Z. AlZahrani and G. P. Srivastava, Density-functional calculations for self-assembled Bi-nanolines on the InAs(100) surface, J. Appl. Phys. 106, 053713 (2009).
18. A. Z. AlZahrani and G. P. Srivastava, First-principles calculations of clean and Bi-induced (2×4) reconstructions on the InP(001) surface, IOP publishing (2009) (extended abstract) 2008
19. A. Z. AlZahrani, R. H. Miwa, and G. P. Srivastava, Theoretical investigation of Mn adsorbates aside self-organised Bi nanolines on hydrogenated Si(001) surface, Surf. Sci. 602, 2789 (2008).
20. A. Z. AlZahrani and G. P. Srivastava, Ca-induced intermediate reconstructions on the Si(111) surface, Phys. Rev. B 77, 235320 (2008).
21. A. Z. Al-Zahrani and G. P. Srivastava, Electronic and geometric investigations of the Ca/Si(111)-(5×2) surface, Appl. Surf. Sci. 254, 8083 (2008).

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<tr><td colspan="4">C.V. of CO-I.4</td></tr>
<tr><td>Name (English)</td><td colspan="3">Abdullah Ali Abdullah AlShaikhi</td></tr>
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<tr><td>Institute / University (Work)
King Abdulaziz Uniersity</td><td>College/ Directorate
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<tr><td>Nationality
Saudi</td><td>Date of Birth
Feb. 1976</td><td>Country of Birth
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<tr><td>Highest Degree
PhD</td><td>University
School of Physics at the University of Exeter, U.K.</td><td>Date of Graduation
2009</td></tr>
<tr><td>Academic Title
Assistant Professor</td><td>Major field
Physics</td><td>Specialization
Solid State Physics</td></tr>
</table>

<table>
<tr><td>Scientific Profile
(Please describe briefly in 5 lines maximum)</td><td>Physics secondary-school teacher (1998 – 2001).
Teacher Assistant (Demonstrator), Physics Department, King Abdulaziz University (2001 – 2003).
Assistant professor, Physics Department, King Abdulaziz University (2009 – until now).
Member of the academic guidance committee, Physics Department, King Abdulaziz University (2010 – until now).</td></tr>
<tr><td>Qualifications
(Please describe briefly in 5 lines maximum)</td><td>PhD in Physics (2009), School of Physics, University of Exeter, UK.
MPhil in Physics (2005), School of Physics, University of Exeter, UK.
BSc in Physics (with minor degree in education) (1997), Faculty of Applied Sciences، Umm Al-Qura University, KSA</td></tr>
<tr><td>Research highlites</td><td>Solid State Physics.
Phonon interactions and thermal transport in bulk and thin film semiconductor materials.
Phonon interactions and thermal transport in semiconductor nanostructures (nanowires، nanotubes and quantum dots).</td></tr>
<tr><td>Fuded Projects</td><td></td></tr>
<tr><td>Patents</td><td></td></tr>
</table>

List of Publications

Some selected papers:

1. A AlShaikhi and G P Srivastava, Specific heat calculations of III-N bulk materials, phys. stat. sol. (c) 3 (2006) 1495-1498

2. AlShaikhi and G. P. Srivastava, Drop and recovery of thermal conductivity of AlN upon UV irradiation, J. Phys. Conf. Series 92 (2007) 012084-87

3. AlShaikhi and G. P. Srivastava, Theoretical investigations of phonon intrinsic mean free path in zincblende and wurtzite AlN, Phys. Rev. B 76 (2007) 195205:1-7

4. AlN AlShaikhi and G. P. Srivastava, Phonon intrinsic mean free path in zincblende, Diamond and Related Materials 16 (2007) 1413

5. AlShaikhi and G. P. Srivastava, Role of additives in enhancing the thermal conductivity of AlN ceramics, J. Phys. D: Applied Phys. 41 (2008) 185407:1-4

6. AlShaikhi and G. P. Srivastava, Thermal Conductivity of single crystal and ceramic AlN, J. Appl. Phys. 103 (2008) 0873554:1-6

7. AlShaikhi and G. P. Srivastava, Quantitative study of the enhancement of the thermal conductivity of AlN ceramics by nano-scale processing, J. Phys. CM 21 (2009) 174207:1-5

8. AlShaikhi, Saswati Barman and G. P. Srivastava, Theory of the lattice thermal conductivity in bulk and films of GaN, Phys. Rev. B 81 (2010) 195320:1-12

YAHOO! MAIL Classic

Re: Research proposal Wednesday, September 14, 2011 8:05 PM

From: "Dong S. Ha" <ha@vt.edu>
To: "EL Sayed Shalaan" <eshalaan@yahoo.com>

Dear Prof. Shalaan,
I am sorry for my late response. I am visiting Korea now and spent a few days in my village during a Korean festival.

Thank you for inviting me as your scientific consultant. I will be happy to accept the invitation. I wish good luck to your proposal and hope for such an opportunity. Regards. Dong

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