Materials Research Prospects in Palestine. Case History: Semiconductor Research at Najah

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Abstract:

Palestine has limited natural resources. Any future development should therefore be based on advanced technology. Such ambitious outlook dictates that Palestine heavily invests in quality teaching and researching in such areas. Materials research is one building block for building advanced technology. The philosophy is simple: we need to develop a technology which intensively demands know-how rather than resources. In short Palestine should develop a technology based on creativity and invention, starting with advanced materials and their applications.
Advanced materials include a wide range of areas such as nanotechnology, thin films, nanodevices, conductive polymers and others. Applications of advanced materials span a number of areas such as: Energy storage devices (super batteries supercapacitors, fuel cells), clean energy (photovoltaics PV, photoelectrochemistry PEC) biotechnology (drug delivery, cancer treatment), superconductivity & superconducting magnets (MRI, super-trains) and other applications (LEDs, electrochromics).

Semiconductors (AC) are a very important area of advanced materials. Almost all contemporary technologies rely on SC systems such as p-n junctions (transistors, diodes, PV, PEC, refrigeration…).
In this plenary, we wish to give one specific example on where Palestinian scientists can target an area of advanced material research and can contribute effectively despite limited resources.

Semiconductor research activity has been established in the laboratories of An-Najah N. University in the mid 1990s. The activity started with modification of mono-crystalline n-Si and n-GaAs semiconductor surfaces for the purpose of controlling band edge positions. This was for the purpose of tailoring band edge positions to catalyze water splitting (into hydrogen and oxygen) by solar light. The objectives were successfully achieved by graduate students at ANU. To simultaneously achieve stability and efficiency of the SC electrode, other techniques were developed here. Monocrystallyne n-GaAs electrodes were enhanced in stability and efficiency using polymeric coatings with electroactroactive ions inside. However, the increasing cost of monocrystalline SC materials affected our objective. Our efforts were then diverted to synthetic thin film SC electrodes. Preparation of enhanced semiconducting materials, in the forms of thin films and nano-scale particles, have then been conducted for the purposes of light-to-electricity and water decontamination strategies, have been established.

Recently our students have been heavily engaged in preparing new classes of n-type semiconducting materials (CdS and CdSe) in the forms of thin films and nano-scale particles using Chemical Bath Deposition (CBD) and Electro-Chemical Deposition (ECD) techniques. Thin CdS and CdSe films were deposited onto FTO/glass systems and are currently being used for light-to-electricity conversion processes. Modification of thin films with different techniques shows promising potential in enhancing efficiency and stability. For the first time, ANU students were able to stabilize CBD-based CdSe films in PEC processes.

Examples of SC research progress at ANU will be highlighted in this presentation. Some technical results and discussions will be presented. This is to give examples to young Palestinian scientists on what they can achieve should they work in advanced materials research, directed towards solving societal problems. It is also intended to attract the attention of decision makers to put materials R&D as a high priority area in the near future.