Renewable Energy as Only-Choice for Mankind: Solar Energy Research Activities at Najah

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Abstract
Human need for energy resources is a fact of life. The demand for energy is continuously increasing with time, and is almost reaching a logarithmic relation. Unfortunately, as profitability is masterminding human current practices with energy resources, human being is doing to himself what dinosaurs did to themselves long time ago. Fossil fuels clearly cause global warming through green-house effects. Nuclear energy proves to be a dreadful alternative, as we have plenty to learn from Chernobyl and Fukushima. Bio-fuels, where energy is produced from agricultural products, are at the first glance promising prospect, give no solution. Unfortunately they are proving to be no alternative, as due to profitability interference, they came at the expense of human food.
Human being can benefit from energy without hurting future life only by following certain strict strategies. This can be achieved by wise utilization of energy sources and by investing in solar energy resources. To guarantee success, scientific thinking and reason should replace current profitability-based practices. A simple calculation, at least in theory shows that available solar energy resources are 120,000 TW. Less than 0.02% of available resources are sufficient to entirely replace fossil fuels and nuclear power which count to about 24 TW nowadays. To our estimation, if we can utilize incident solar light on one third of Algeria desert, at 10% conversion efficiency, the resulting energy is sufficient to meet current human demands. Quran revelations that Earth has enough resources for human beings are absolutely true (وقدر فيها أقواتها), if we scientists positively think of these facts. Moreover, solar energy technology needs to be seriously considered as alternative at the global level. Industrialized and developing countries need to work on such areas. Palestine should participate in such technologies for many reasons. 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 solar energy 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 in solar energy. Semiconductors (SC) 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, refregiration, ….).
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 mid 1990s, and is now housed at SSERL. 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. Monocrystalline 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 SC materials, in the forms of thin films and nano-scale particles, has then been conducted for the purposes of solar photo-voltaics and for water purification.

SSERL researchers have been heavily engaged in preparing and enhancing SC thin films. Nano-thin CdS and CdSe films, 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 researchers 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 draws inroads for young Palestinian scientists to work on advanced materials while keeping in mind their 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.