

Feasibility of Non-thermal Plasma Assisted Semiconductor Material Synthesis for Thermoelectric, Photovoltaic and Energy Applications

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Abstract—Silicon being the major component in the semiconductor industry has proved itself very effective in myriad applications that include its use in transistors, energy storage, photovoltaics etc. A boom into its efficiency has emerged with the use of the Nano technology, when the same material is used at Nano scale for the fabrication of the devices in the said applications, it provides promising characteristics. Yet the synthesis techniques for the usage of the silicon as material at Nano scale encounter myriad hurdles, however, still the application of non-thermal plasma at Nano scale has found promising results in this field. It could bring about a huge improvement into its efficiency and can thus become ideal for the vast industrial uses. Yet it encounters several issues that makes this practice economically not feasible, like it needs more time to process such material rather than the conventional methods to synthesize materials on the liquid, solid or gas phases have their own short comings which will result into certain compromises the synthesizers have to deal with based on the properties of the end finished product. On the contras, Non-thermal plasma processing is found cost effective with properties like lack of agglomeration and more efficiency.

Index Terms—Nano crystals, silicon, synthesizers, photovoltaics.

I. INTRODUCTION

Silicon belongs to group IV of the periodic table with its place at the 4th group it is half way up in between the metals and halogens. 4 electrons in its valence shell makes it ideal for the use to the semi-conductor industry where the important applications of it involve the use of the silicon in energy storage devices, transistor manufacturing and photovoltaics etc. Still there is provision of the improvement into the said material it is being investigated that if the synthesis of the silicon is processed at Nano scale, it could bring about a huge improvement into its efficiency and can

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thus become ideal for the vast industrial uses. Yet it encounters several issues that makes this practice economically not feasible, like it needs more time to process such material rather than the conventional methods, particles may not be well distributed even with the use of the most effective modern techniques in this line and the prohibitive cost being needed for the establishment of this facility. The use of the non-thermal plasma for the synthesis of these particles is a new facet of this technology that has been introduced recently and has shown effective to address the above three short-comings to certain extent. The semiconductors group elements have the tendency to tune the property in them to address the targeted properties needed in them for the issues like surface coating of desired properties. Such a property can be achieved using desired discernibility into the solvent to achieve the desired end. Non-Thermal Plasma can change the chemistry of the surface by bringing the changes into the gas phase of the solvent. A visible advantage of this process can be seen in using the group IV elements coatings on the anode in the batteries to improve its stability.

II. NANO MATERIALS CHARACTERISTICS

Nano materials offer a very promising side of properties due to their inherent ability to be dispersed uniformly, thus establishing the uniform core of properties across all the material body. During the last decade several improves in this regard are the clear proof of this very fact that this technology has proved its effectiveness on every front [1], [2]. The usage of the semi-conductor materials synthesized and fabricated using Nano technology has not merely confined to semi-conductor applications, rather it ranges its usage in biotechnology, military applications, energy production, storage, environmental technologies and in medical applications. Being lying between the very small i.e. atomic scale and very large i.e. macro scale, Nano materials can change the properties of the same material to considerable extent. Most of the properties that include mechanical, electrical, optical and thermal can be improved if the material is synthesized and processed from bulk to Nano scale. The main change that has been brought into the properties of the material is due to the changes in the energy level and band gap, where any change into these two parameters bring change into the properties of the material that are dependent on size. Yet all the elements from group 2 till group 6 have been used in myriad technologies including the photovoltaics, light emitting diodes etc. [3]. But group 4 elements have less