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Thesis Title: Synthesis of silicon nanowires for solar cell applications

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Abstract:

The work reported in the thesis is basically related to the synthesis of aligned silicon nanowires and nano-texturization process on large area silicon wafers to enhance the light absorption. The work includes application of silicon nanowires and nano-textured surfaces in solar cells. Silicon nanowires were synthesized by localised chemical etching of silicon by using silver as a catalyst which was carried out by electroless metal deposition (EMD) of Ag in a solution consisting of dilute hydrofluoric acid (HF) containing silver nitrate (AgNO_3). Nano-texturization of silicon was carried using almost a similar process. Effect of different growth conditions such as etching time, temperature, solution composition on the morphology, growth and properties of silicon nanowires was studied. Solar cells were fabricated by using silicon nanowire arrays and nano-textured surfaces. The performance of the solar cells made on the surfaces of different topographies was compared with a control cell having conventional structure.

Chapter 1: The major motivation behind this thesis is discussed. It gives an overview of global energy scenario and rising concerns about global warming. The need of new and

innovative ideas in solar cell fabrication is also briefly touched. The literature survey for silicon nanowires growth and solar cells a subject matter of the present work is given in detail.

Chapter 2: This chapter describes about briefly about the device physics of solar cells and their characterization. In this chapter details of different experimental tools used to carry out the present work have been discussed. The different characterization techniques used to study silicon nanowires and silicon solar cells are also briefly discussed.

Chapter 3: The growth mechanism of silicon nanowires by electroless metal deposition technique is discussed in Chapter 3. Effect of various parameters like temperature, time and etching solution concentration on growth of silicon nanowires is reported and analyzed. Properties of silicon nanowires like structural, optical and material properties are also reported in this chapter.

Chapter 4: Application of silicon nanowires in silicon solar cell is discussed in Chapter 4. The protocol used to fabricate silicon nanowires based solar cells and their characteristics are reported. The effect of silicon nanowires parameters on various electrical characteristics of solar cells are discussed in detail in this chapter.

Chapter 5: Process of silicon surface nano-texturization that was developed during this course of work and subsequently applied for silicon solar cell fabrication is described in this chapter. Mechanism of silicon nano-texturization has been discussed along with effect of nano-texturization on the solar cell performance.

Chapter 6: Theoretical model was developed for the anomalous high photovoltages observed in obliquely deposited thin films. In Chapter 6, various observations made on such thin films are explained with the help of the phenomenological model developed.

Chapter 7: In the last chapter the overall results and conclusions are summarized. The scopes for further study in this area are also discussed briefly.