Chapter 10
A Review of Various Nanostructures to Enhance the Efficiency of Solar-Photon-Conversions

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ABSTRACT

The problem of dwindling energy can be attributed to the rapidly increasing world-wide energy demand, leading to an urgent need for alternative energy-harvesting technologies to sustain the economic growth by maintaining our appetite for energy. Among them, solar-energy-harvesting is most promising, and the huge demand for clean, cost-effective, and cost-efficient energy can be met by solar energy. The large-scale solar energy utilization has not become practical because of the high cost and inadequate efficiencies of the current solar-energy-conversions. Nanotechnology

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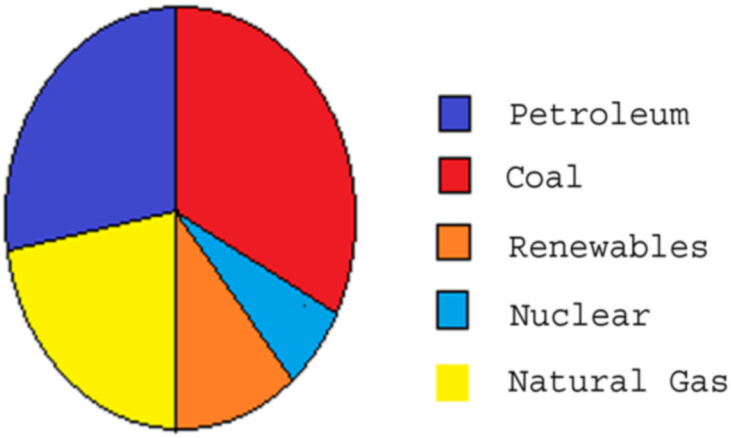
offers tools to develop cost-effective and cost-efficient technologies for solar-energy conversions. Nanostructures, such as nanowires, nanopillars, nanodomes, nanorods, quatumdots, nanoparticles, etc., facilitate photon absorption, electron transport, and electron collection properties of the solar-energy-conversion devices. This review specifically summarizes the contribution of the nanotechnology to photovoltaics, dye-sensitive solar cells, quantum-dot-sensitized solar cells, and solar hydrogen production devices.

INTRODUCTION

Energy supply is arguably one of the most important challenges that the whole world is facing today and a big concern in future. We heavily rely on the fossil fuels for this energy demand, which, being non-renewable energy sources will lead to quick depletion of these resources. As the population is increasing at a faster rate, so is the energy consumption as shown in Figure 1a. The ever increasing energy demand, of which ~ 65% is currently fulfilled by coal and petroleum (Figure 1b) has disturbed the life on all fronts (economically and technically, ecology and health, present and future). These resources are harmful to the atmosphere as their consumption not

Figure 1. It clearly demonstrates that petroleum, coal and natural gas are the most utilized fuels over renewables



World consumption of energy by type for 2007