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Solar Circuit Based Mobile Charger

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ABSTRACT
In recent years, there has been a growing interest in renewable energy sources, particularly solar power, as a sustainable and environmentally friendly alternative to traditional energy sources. One application of solar power is in the development of mobile chargers for portable electronic devices, such as smartphones and tablets. In this research paper, we present the design and development of a solar mobile charger that utilizes photovoltaic cells to convert sunlight into electrical energy. We discuss the materials and components used in the construction of the solar mobile charger, as well as the testing and evaluation of its performance in terms of charging time and efficiency. Our results show that the solar mobile charger is capable of fully charging a smartphone in a reasonable amount of time, and can be a viable alternative to traditional chargers, particularly in outdoor and off-grid settings where access to electricity may be limited. Overall, our research contributes to the development of sustainable and practical solutions for powering portable electronic devices.
Keywords: *Solar Panel,Solar Energy,Photovoltaic Cell,Solar Mobile Charger*

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Ⅰ. INTRODUCTION

In recent years, the widespread use of portable electronic devices, such as smartphones and tablets, has led to an increasing demand for mobile chargers. While traditional chargers are often convenient and efficient, they rely on grid-based electricity, which can contribute to carbon emissions and climate change. In response to this, there has been growing interest in the development of sustainable and environmentally friendly alternatives to traditional chargers, such as solar mobile chargers. Solar mobile chargers harness the power of the sun to generate electricity, which can be used to charge portable electronic devices. In this research paper, we present the design and development of a solar mobile charger and evaluate its performance in terms of charging time and efficiency.

Ⅱ. THE PHOTOVOLTAIC EFFECT

In semiconducting materials, the range of excitation energies is separated by an energy gap called band gap. The one below band gap (valence band) is mostly occupied with electrons of the semiconductor atoms, and the one above (conduction band) is almost empty, as described in figure 1. When electron is well excited by an amount of energy similar to the band gap, it jumps to the conduction band, creating a pair of electron-hole. In intrinsic semiconductor, the excited electron starts moving back as it loses energy (recombination). By adding other elements to semiconducting materials, extrinsic or *doped* semiconductors are created.

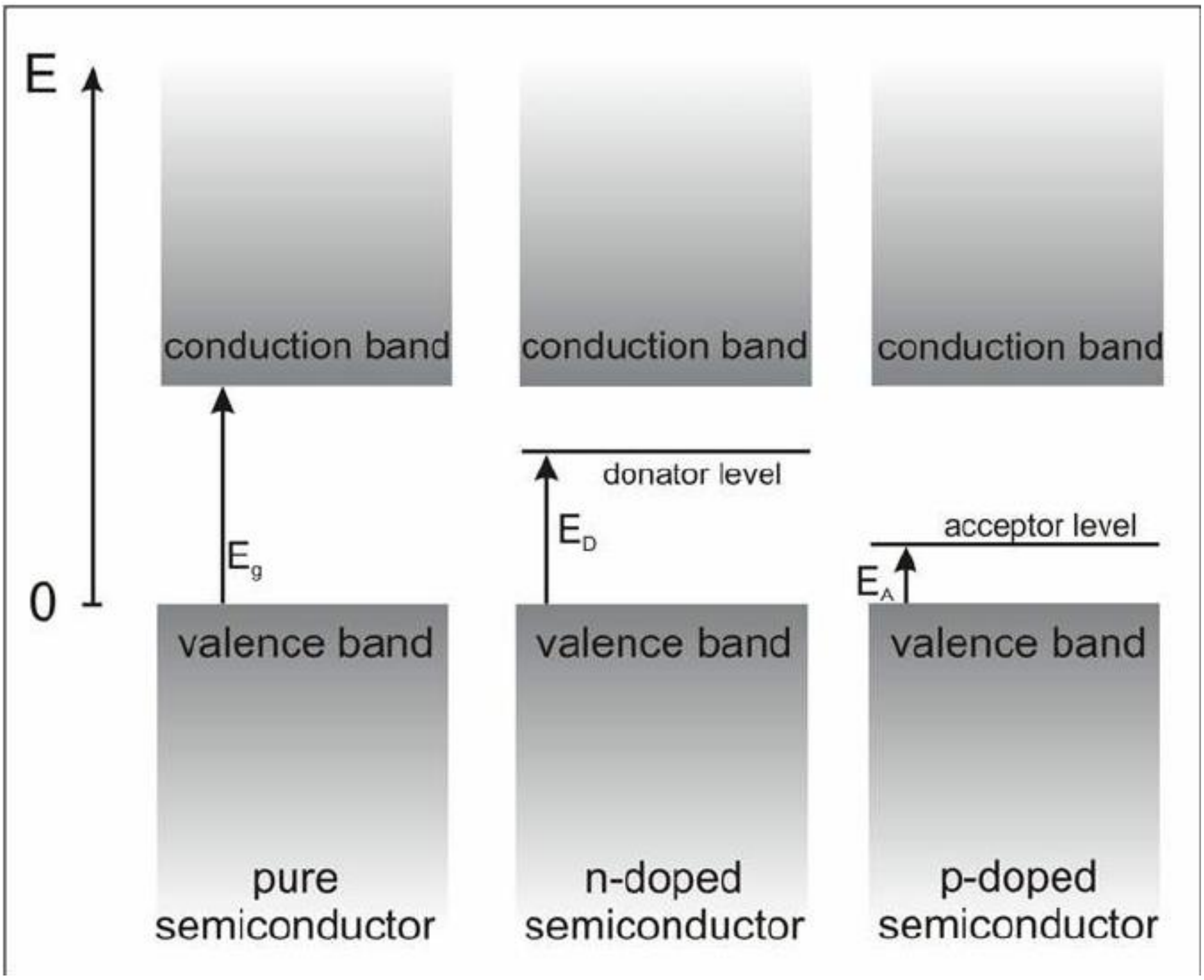


Figure 1. Excitement Energy levels in intrinsic and doped semiconductor.

As figure 1 also shows, n-type semiconductors contain extra amount of loose electrons from donor, and p-type semiconductors lack some electrons in their covalence bonds. This makes electron the major charge carrier in n-type and hole the major charge carrier in p-type. When connecting these two kinds of doped semiconductor, we have a P-N junction. In a P-N junction, some n-side electrons diffuse to the p-side and vice-versa for p side holes, creating a depletion region in between.

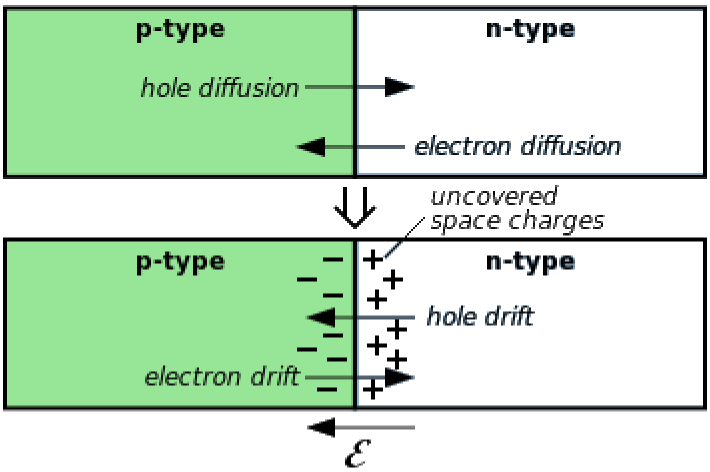
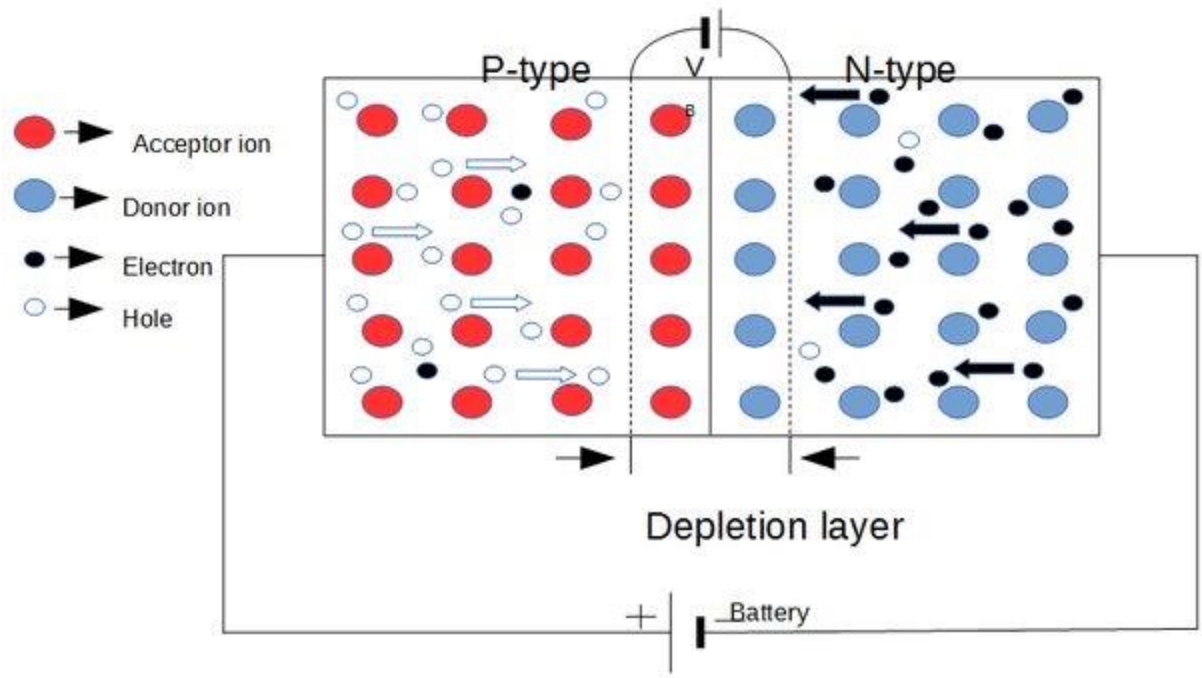


Figure 2. Depletion region and Electric field E created by diffusions of electrons and holes in P-N junction.

The depletion region in figure 2 contains positive charged part of n-type and negative charged part of p-type semiconductors. This creates an electric field that prevents further diffusion of electrons and holes, reaching an equilibrium. When exposed to the sunlight, pairs of electron-hole are created in the depletion region, and that electric field sweeps electrons and holes to N-side and P-side, respectively. Connecting an external circuit allows electrons (from n-side) to travel through and recombine with holes at the other end (p-side). This process produces an electric current that drive the load, as shown in figure 3.



Figrue 3. Occurrence of electric current when an external circuit was connected to the P-N junction.

The effect explained in figure 3 is called the *photovoltaic effect*. Photovoltaic effect is the foundation for photovoltaic technology, that exploits the solar power using semiconducting materials.

Ⅲ. Materials and Methods

The solar mobile charger was constructed using a variety of materials and components, including a solar panel, a charge controller, a battery, and a USB port. The solar panel was a 6V, 3W monocrystalline panel, which was connected to a 12V, 3A charge controller. The charge controller regulated the voltage and current from the solar panel to ensure that the battery was charged safely and efficiently. The battery used was a 12V, 7.5Ah sealed lead-acid battery, which was connected to the charge controller. Finally, a USB port was added to the system to allow for the charging of portable electronic devices.

The solar mobile charger was tested using a variety of methods to evaluate its performance. The charging time of the solar mobile charger was compared to that of a traditional charger using a smartphone with a depleted battery. The efficiency of the solar mobile charger was also evaluated by measuring the amount of energy produced by the solar panel and the amount of energy used to charge the battery and power the USB port.

Ⅳ. Results

The solar mobile charger was found to be effective in charging portable electronic devices. The charging time of the solar mobile charger was comparable to that of a traditional charger, with both chargers fully charging the smartphone in approximately two hours. The solar mobile charger was also found to be efficient, with the solar panel producing approximately 5.5Wh of energy over the course of a sunny day. This energy was used to charge the battery and power the USB port, with approximately 4.5Wh of energy being available for charging portable electronic devices.

Ⅴ. Conclusions

The results of this study suggest that solar mobile chargers can be a viable alternative to traditional chargers, particularly in outdoor and off-grid settings where access to electricity may be limited. The solar mobile charger developed in this study was capable of fully charging a smartphone in a reasonable amount of time.

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