Value-Added ABC Semiconductor Material for Various Applications

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1. Introduction

We would like to propose a novel semiconductor material that can show both plasmonic and electric properties. Moreover, using smectite clay, whole structure of this material can be designed so that it is easily printed in any kinds of solvents. As is shown in Fig.1, ABC semiconductor means the desirable composite of Ag nanoplate, boron, and clay[1]. Plasmon resonance is controlled around Ag plate surface by adjusting its size and the plasmon energy can be transferred to boron semiconductor and excite it[2]. ABC semiconductor will pave the way for various applications, such as energy harvesting cells with storage effect, functional films that reflect or absorb only the light with specific wavelength up to infrared region, non-contact antibacterial coating by usage of strong electric fields induced by plasmon resonance, as well as SERS. In this paper, a photo-voltaic cell as one of applications has been studied.

2. Application for Photo-voltaic Cell

The principle of photo-voltaic cell we are going to describe is completely different from conventional solar cells. We don't aim insistently high efficiency, but rather sustaining energy harvesting devices working in infrared light with thin and light weight. Fig.2 illustrates the structure of photo-voltaic cell with ABC and BC inserted by two ITO electrodes. When light illuminates onto the cell, free electrons oscillate collectively at the surface of Ag plates, induce charge accumulation like a capacitor. BC, the composite of boron nitride and clay, is a soft material to well contact to ABC and designed to have minimum impedance without a hysteresis in its I-V curve. Three different compositions of ABC were applied.

The result is summarized in Fig.3. Our cell produced its voltage with its specific rise time, which shows that the plasmon resonance surely induces charge accumulation. Higher boron ratio increased photo-voltage with smaller rise time, which can be systematically accounted for. In this experiment light wavelength from 425 to 660 nm with 9.07 cd was used. Although it is not infrared power generation, infrared application will sooner be realized because over 2 micrometer size of Ag plates that correspond to resonance wavelength well more than 1000nm has been successfully produced.

3. Conclusions

We have shown a good example of photo-voltage generation, which proves ABC semiconductor's high potential as a versatile material. We are now verifying ABC semiconductor would be open to other various possible applications.

Acknowledgements

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References

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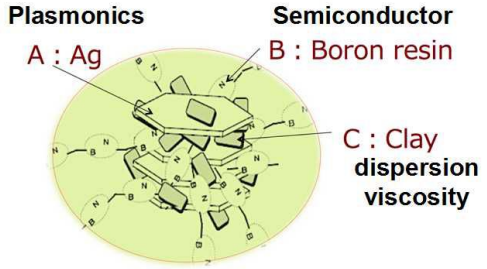

Fig.1. Schematic diagram of ABC semiconductor

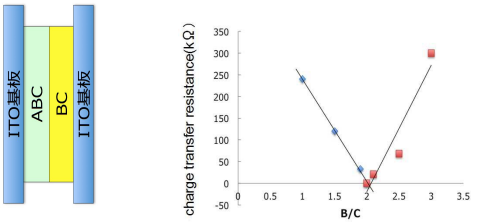

Fig.2. Structure of photo-voltaic cell and B/C ratio dependence of BC resistance.

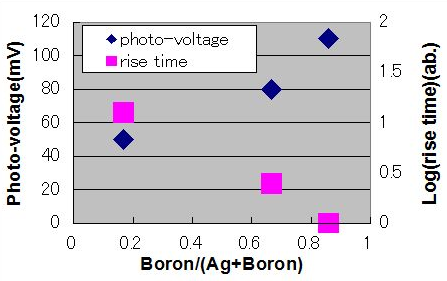

Fig.3. Boron ratio dependence of photo-voltage and rise time. Rise time is normalized at boron ration of 0.86.