Materials Challenges for Alternative Energy Resources

Sanjay Behura, Sasmita Nayak and Omkar Jani

Solar Energy Research Wing
Gujarat Energy Research and Management Institute (GERMI)
Research, Innovation and Incubation Centre, Gandhinagar 382007, Gujarat, India

* E-Mail: sanjay.b@germi.res.in; Tel.: 079-23275377; Fax: 079-23275380

Abstract

Graphene, a 2D single atomic layer of crystalline carbon, arranged in a honeycomb lattice. The important properties of graphene involve Dirac electronic band-structure, high room-temperature carrier mobility of 15,000 cm^2/V.sec, Fermi velocity of 10^6 m/sec, tunable band gap and visible transparency of 97.7%. The structural uniformity makes graphene a near-ideal flat surface for conformal assembly towards device integration. Graphene has shown great potential for creating photovoltaic solar devices owing to its high optical transmittance, electrical conductivity and surface area. In this study we are aiming to identify and develop an appropriate technique for large area graphene deposition to replace TCO's in photovoltaic devices. Moreover, it is intended that graphene deposition be tailored for integration within an optoelectronic device such as a crystalline silicon solar cell. The preliminary envisaged method of graphene deposition is CVD. We are also fabricating graphene by chemical oxidation and reduction of graphite and optimizing the techniques for large area deposition.

Keywords: Graphene, Solar cell, Transparent conductor, Electrode, CVD.

References

[1] S. K. Behura, P. Mahala, A. Ray, I. Mukhopadhyay, O. Jani, "Theoretical simulation of photovoltaic response of Graphene-on-semiconductors," **Applied Physics A: Materials Science and Processing**, Vol. 111, p. 1159-1163 (2013). [SCI IF: 1.545]

[2] S. K. Behura, I. Mukhopadhyay, A. Hirose, Q. Yang, O. Jani, "Vertically-oriented few-layer graphene as an electron field-emitter," **Physica Status Solidi (A): Applications and Materials Science**, Vol. 210, p. 1817-1821 (2013).

[3] S. K. Behura*, S. Nayak, I. Mukhopadhyay, O. Jani, "Junction characteristics of chemically-derived graphene/p-Si heterojunction solar cell," **Carbon**, Vol. 67, p. 766-774 (2014).

[4] S. K. Behura, P. Mahala, S. Nayak, Q. Yang, I. Mukhopadhyay, O. Jani, "Fabrication of bi-layer graphene and theoretical simulation for its possible application in thin film solar cell," **Journal of Nanoscience and Nanotechnology**, Vol. 14, p. 3022-3027 (2014).

[5] K. Batra, S. Nayak, S. K. Behura*, O. Jani, "Optimizing Performance Parameters of Chemically-Derived Graphene/p-Si Heterojunction Solar Cell," **Journal of Nanoscience and Nanotechnology** (2014). [Accepted]