Dieter M Gruen, J Material Sci Eng 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.036

conferenceseries.com

5th World Congress on

Materials Science & Engineering

June 13-15, 2016 Alicante, Spain

Dieter M Gruen

Dimerond Technologies LLC, USA

High temperature solar cell for single facility co-generation of photovoltaic and thermal electricity: A breakthrough approach to affordable solar power

Solar cells capable of converting sunlight to electricity at 400°C would enable the doubling of current Concentrating Solar Power (CSP) plant efficiencies without substantially increasing their capital cost. Being able to convert both photovoltaic and thermal energy in a single facility reduces the cost of solar electricity by a factor of almost two making it cost competitive with fossil and nuclear fuel generated power. A graphene/wide band-gap semiconductor (G/WBGS) diode that rectified current at temperatures approaching 900°C, constructed by the author and his collaborators some time ago, showed the remarkable temperature behavior of this new heterojunction. The elucidation of the properties of graphene in fact earned Geim and Novoselov the 2010 Nobel Prize in Physics. Graphene absorbs light more strongly than any other material and does so independent of wavelength. The interaction of photons with the near relativistic electrons in graphene is determined by the theory of quantum electrodynamics formulated by Feynman, Tomonaga and Schwinger (Nobel Prize in Physics, 1965). The basic architecture of the high temperature solar cell consists of WBGS aligned nanowire cores surrounded by graphene shells. Crucially, experimental as well as theoretical studies show that at G/WBGS n/p junctions, the kinetics of charge transfer are strongly favored over electron hole recombination rates. Furthermore, the WBGS nanowires have been shown to be excellent optical waveguides whose nanophotonic properties ensure total light harvesting by the graphene shells over distances of only a few microns. Graphene's large electrical conductivity and hole mobility, exceeding even the electron mobility, allows it to function as its own hole carrying electrode. Additionally, its demonstrated capacity for multiple carrier generation especially at the high light intensities of CSP plants suggests that graphene based solar cells could exceed the Shockley/Queisser conversion efficiency limit established for silicon solar cells. These recent developments set the stage for achieving the long sought goal to create high temperature solar cells. The straightforward design elaborated above is eminently suited to large scale economical fabrication using abundant, environmentally benign materials.

Biography

Dieter M Gruen did his PhD in Chemical Physics from the University of Chicago. For many years, he was Associate Director of the Argonne National Laboratory Materials Science Division and is the recipient of many honors and awards including the 2000 Medal of the US Materials Research Society for his discovery of ultra nanocrystalline diamond films.

dietergruen@comcast.net