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GQD layers for Energy-Down-shift layer on silicon solar cells by kinetic spraying method

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Graphene quantum dots (GQDs), a new kind of carbon-based photo luminescent nanomaterial from chemically modified graphene oxide (CMGO) or chemically modified graphene (CMG), has attracted extensive research attention in the last few years due to its outstanding chemical, optical and electrical properties. To further extended its potential applications as optoelectronic devices, solar cells, bio and bio-sensors and so on, intensive research efforts have been devoted to the CMG. However, the CMG, a suspension of aqueous, have problematic since they are prone to agglomeration after drying a solvent. In this study, we synthesized the GQDs from graphite and deposited on silicon substrate by kinetic spray. The photo luminescent properties of deposited GQD films were analyzed and compared with initial GQDs suspension. In addition, its carbon properties were investigated with GQDs solution properties. The properties of deposited GQD films by kinetic spray were similar to that of the GQDs suspension in water. We could provide a pathway for silicon-based silicon based device applications. Finally, the well-adjusted GQD films with photo luminescence effects will show Energy-Down-Shift layer effects on silicon solar cells. The GQD layers deposited at nozzle scan speeds of 40, 30, 20, and 10 mm/s were evaluated after they were used to fabricate crystalline-silicon solar cells; the results indicate that GQDs play an important role in increasing the optical absorptivity of the cells. The short-circuit current density (Jsc) was enhanced by about 2.94 % (0.9 mA/cm2) at 30 mm/s. Compared to a reference device without a GQD energy-down-shift layer, the PCE of p-type silicon solar cells was improved by 2.7% (0.4 percentage points).

Keywords: Down-conversion, Energy-Down-Shift, graphene, graphene quantum dot

ET-P010

Flexible device 상용화를 위한 flexible supercapacitor 연구

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스마트폰, 태블릿 등의 디바이스의 발전에 따라 휴대성이 매우 중요해졌다. 디바이스의 크기, 두께, 유연성에 관한 연구가 활발히 진행되고 있으며, 그 중에서도 energy storage device의 flexibility를 향상시키는 연구가 주목 받고 있다.

Energy storage device의 성능 향상을 위해서는 power density를 높여야 하며 flexibility를 위해서는 전극판과 전극소재 간의 부착력을 증가시켜야 한다. 본 연구에서는, power density와 소재 간의 부착성을 개선시키기 위해 기존 graphene보다 표면적이 넓으며 power density가 좋고 전극판과의 부착성이 좋은 hybrid GNP-CNT를 사용하였다. 그리고 Ag NWs/CNT PET film 을 사용하여 전도성이 있는 flexible한 전극판을 사용하였다. SEM 측정을 통해 표면 분석을 하였고, sample에 패턴을 하고 Bending test를 하여 부착성을 확인하였다. 또한, CV curve를 측정하여 supercapacitor의 특성을 확인하였다.

향후, MnO_2 NWs를 hybrid GNP-CNT에 합성시킴으로 energy storage device의 energy density를 더욱 향상시키는 연구를 진행할 것이다.

Keywords: flexible, supercapacitor, energy storage