Semitransparent Organics Solar Cells

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CONTEXT

70% of world population is expected to live in cities by 2050 and in order to address world increasing energy consumption new solutions and effective strategies must be found. The concept of smart cities serves as foundation to turn cities of today into the sustainable cities of the future. Nowadays most of energy consumed in cities is produced outside urban areas and, even if environmental and security of supplies concerns have increased, it is hard to implement decentralized renewable energy systems in such context. One very important reason is the physical lack of space.

CONCEPT

The implementation of silicon photovoltaic is inspiringly contributing to increase the share of renewable energy, year by year. Nonetheless, silicon solar cells are bulky and opaque, and therefore particularly suited only for roof installation and not for other challenging building integrated solutions, like building windows. Organic solar cells are a thin film technology that uses photoactive layers with thicknesses in the range of 100 nm. This allows the active layer to be intrinsically semitransparent. This type of solar cells normally look opaque to the human eye because a metallic top contact is present, which efficiently collects the generated current. In a semitransparent device the top opaque electrode is substituted with a suitable transparent contact. Semi transparent organic solar cells have the potential for interesting applications, such as integration into windows for buildings, cars and screens of electronic devices.

PROJECT DESCRIPTION

The project was aimed to fabricate and characterize efficient semitransparent organic solar cells. The top transparent contact represents the most challenging aspect for the fabrication of efficient semitransparent organic solar cells. After having investigated electrodes involving conductive polymer PEDOT:PSS in combination with evaporated metal grid and thin metal layers sandwiched between two dielectrics, considerable attention has been given to silver nanowires (AgNws) electrodes, due to their fascinating properties. There are different suitable materials that can be used in combination with the metal nanowires to obtain a good top contact. These are needed to fill the void in the nanowires network, in order to enhance lateral conductivity, leading to lower sheet resistance and hence better charge extraction. Therefore different composite transparent electrodes with different optical and electrical properties and consequently different performances in the solar cell are possible. This regards not only the specific materials used in combination with the metal nanowires, but also how they are processed. After further investigation of the promising PEDOT:PSS – AgNws composite electrode, a single layer that combines the function of top transparent electrode and hole transport layer has been obtained. This was done by mixing the two aforementioned materials together and processing in one step, instead of processing them on top of each other.