PO3010

# Control of oxygen content with pulse width: a powerful way to deposit transparent nickel oxide thin films by reactive HiPIMS

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The organic photovoltaic cells (OPV) up to now convert 8.3% of the solar spectrum and Heliatek has lastly reported efficiency as high as 9.8% for tandem bulk heterojunction solar cells. For the classical OPV, charge carrier transport from the photosensitive polymer is performed by incorporation of organic semiconductors which are in contact with metallic electrodes. The interfaces between metal and organic components as well as the natures of organic semiconductors play an important role for the effective charge transport and degradation processes. Limiting the sensitivity of polymer materials becomes the path for development of hybrid OPV. One possible way is to use inorganic semiconductors. We propose the NiO as p-type semi-conductor to ensure charge carriers and electron/hole blocking layers. The characteristic wide gap energy permits thin films of NiO to achieve high transparency. We have deposited transparent p-type semiconductive NiO thin films on the conductive glass by reactive HiPIMS using a commercial power supply Solvix HiP3. The characterization of the films deposited by DC reactive magnetron sputtering, show that depending on the oxygen content, NiO grows along preferential orientations: either the most dense [111] direction for low oxygen percent or [200] for higher oxygen content. In the case of HiPIMS discharge, we have fixed the amount of oxygen content in the discharge and investigated the influence of the pulse duration on electrical parameters. It appears that decreasing the pulse duration leads to an increase in the maximum discharge current and in the maximum floating potential. Furthermore, between 10 and 20 µs, we have observed the same behaviour than in the DC case for NiO thin films obtained with varying oxygen content. On the basis of SEM and HRTEM observations we discuss about the advantages and disadvantages of HiPIMS in terms of density and crystallinity but also in terms of photovoltaic efficiency.

**Keywords**
HiPIMS
Nickel Oxide
p-type transparent semiconductor