Hydrothermal growth of ZnO nanorods for application in photovoltaic cells

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Zinc oxide is extensively studied II-VI semiconductor with a direct energy gap of about 3.37 eV at room temperature and high transparency in visible light spectral region. Due to these properties, ZnO is an attractive material for applications in photovoltaic, electronic and optoelectronic devices. ZnO nanorods, due to a well-developed surface, have potential of applications in sensor technology. It is also increasingly common to discuss the potential use of such nanorods in random lasers, where the crystallographic quality is extremely important.

In this work we present a new inexpensive method of the ultra-fast growth of ZnO nanorods from the aqueous solution. This environment friendly and fully reproducible method allows growth of nanorods in few minutes time on various substrates, without any catalyst or complexing agent on large areas. We have significantly improved the growth method and it is now possible to growth the nanorods on substrates of sizes of 15.6 cm x 15.6 cm (size of a standard PV cell) in less than one minute. More importantly, this method does not require high purity growth conditions (water, precursors).

The possibilities of applications of this technology have been presented in many areas, e.g. ZnO nanorods in conjunction with ZnO:Mg and ZnO:Al layers deposited by ALD (Atomic Layer Deposition) we successfully applied in simple-architecture photovoltaic cells (efficiency reach 14%) deposited on low-price Si p-type substrate. The role of the nanorods is twofold, firstly the nanorods stands a better substrate for ALD growth, thanks to which the layers are of better quality and, thanks to the extended surface of nanorods, they cause better "light trapping" than commercial PV cells with nanostructurization.

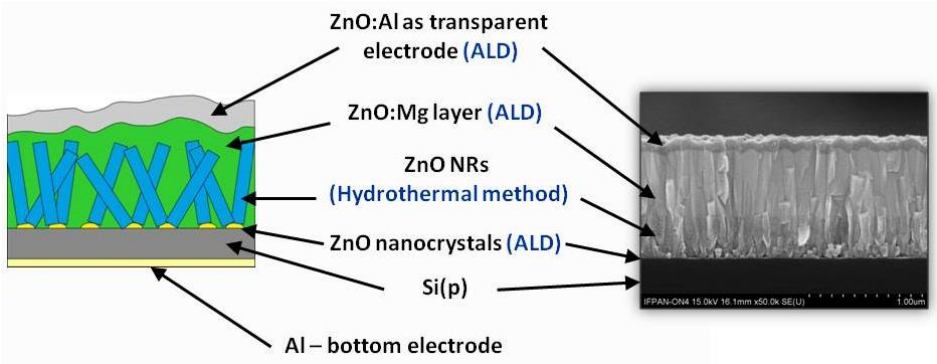

Fig. PV cel with ZnO nanorods & ALD layers growtn on p-type Si substrate.

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