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PROPERTIES OF SnO_2:F/p-type aSI:H INTERFACE IN THIN FILM a-Si:H SOLAR CELLS

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In this work, we present the results of the electrical characterization and the simulations of heterojunctions between transparent conductive oxide (TCO) and hydrogenated amorphous silicon (a-Si:H), with the aim to improve the performance of *p-i-n* diode a-Si:H thin film solar cells. In an a-Si:H solar cell the optical and electrical performance of the TCO play an important role. For example, the effect due to the distributed resistance of the TCO causes the performance degradation of the solar cell [1,2]. One of the most critical parts of a homojunction a-Si:H solar cells is the interface between TCO and p-type a-Si:H. Structures composed by molybdenum (Mo), p-type a-Si:H and SnO_2:F were fabricated by STMicroelectronics (Catania, Italy) in order to study the properties of this heterojunction. Capacitance-voltage (C-V) and current-voltage measurements (I-V) at different temperatures were performed and a capacitance model was proposed. Firstly, we checked the reproducibility and the uniformity of the investigated heterostructures. The I-V curves are slightly asymmetric and show two regions: a linear region (ohmic) up to voltages |V| = 0.1 V and a superlinear region (power-law) for |V|>0.1 V [2]. Transport mechanisms such as diffusion, recombination and SCLC were tested without success in high voltage region. Besides, the Mo/p-type a-Si:H contact can not be considered ohmic because the symmetry in the I-V suggested that the transport mechanism is the same for both positive and negative voltages. Hence, the current is a reverse current of two diode back to back connected. We also simulate the transport mechanism by using the 1D simulator SCAPS 2.9.03 [3]. We fitted simultaneously the I-V curves with the simulations and the C-V curve with a proposed analytical back to back diode model [4] at different temperatures. We determine in the thermally assisted tunnelling the transport mechanism and a band diagram was proposed [4]. We also determine the presence of an high interface defects density of $4.0\times10^{13}\ cm^{-2}$. The Trasversal Electron Microscope (TEM) has showed an uniform a-Si:H layer and the presence of texturization. The sample, prepared using the Focused Ion Beam (FIB), presents some holes at the interface SnO_2:F/p-type a-Si:H (Fig. 1). These holes indicate the presence of weak bonds at the interface SnO_2:F/a-Si:H and hence of high density of interface defects as confirmed by analytical and simulation study [4].

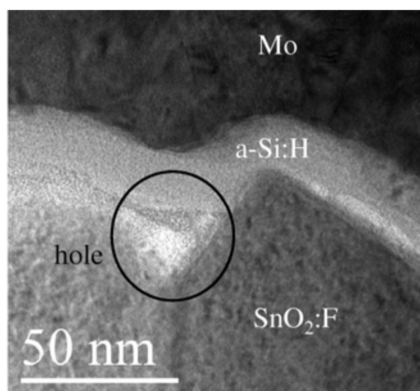

Fig.1 TEM of heterostructures Mo/p-type a-Si:H/SnO_2:F under study.

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