Substrate influence on electrical properties of the Mo back contact for thin-film solar cell.

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A direct impact of substrate on the back contact properties of thin-film solar cells cannot be neglected in case of metallic sheets, mainly, because of roughness and impurities diffusion. In this work, the influence of substrate roughness on Mo back contact sheet resistance was preliminary studied. The roughness of different substrates was analyzed by DEKTAK 150 profilometer. Next, an advanced Mo back contact was deposited. Finally, the resulting sheet resistance of the back contact was measured by 4-point probe technique.

For thin-film solar cell application, flexible substrate is an interesting alternative to traditional glass for many reasons among which, mainly, the potential application of roll-to-roll processing. Among the variety of flexible substrates, steel sheets attract a particular attention because of their thermal stability, vacuum compatibility and low-cost capability. To avoid the drawback of a steel sheet, i.e. diffusion of metallic impurities to subsequent layers, a barrier layer (BL) is applied, which brings electrical insulation, diffusion protection and makes the substrate surface flatter.

In this study, different substrates with thickness Th (Table 1) were used for deposition of 0.52 µm of advanced Mo back contact in order to identify their influence on the electrical properties of the back contact. As the insulating layer for steel substrates, an industrial solgel was used with thickness of 15 µm. The back contact was deposited by magnetron sputtering.

Name of substrate	Th, µm	Ra, µm	Rz, µm	R□, Ohm/sq
DC06 steel with BL	800	0.2	1.5	1.63
DC04 steel with BL	250	0.2	1.5	1.49
Soda Lima Glass (SLG)	3000	0.02	0.5	1.35
Si-wafer	525	0.01	0.1	1.39

Table 1. The list of substrates with characterization parameters

The roughness values were measured by DEKTAK 150 profilometer with respect to ISO standards. The results are presented in terms of average roughness Ra and maximum height Rz of the assessed profile values.

The electrical properties are expressed by resulting sheet resistance R□, which was measured by 4-point probe technique. All values were compared to the reference series of 1 µm Mo back contact on glass substrate produced at AGC with R□=0.5 Ohm/sq.

The results show for flatter substrates, a decrease of sheet resistance by about 20%. An important issue is to distinguish either this difference comes from roughness improvement, or if it is related to the nature of substrates. For this, the same substrates with different roughness should be checked. Unfortunately, even the flattest substrates like glass or Si-wafer show 3 times higher sheet resistance than the reference samples. The next step should be to define the influence of deposition parameters, composition of advanced Mo back contact as well as temperature influence on the sheet resistance.