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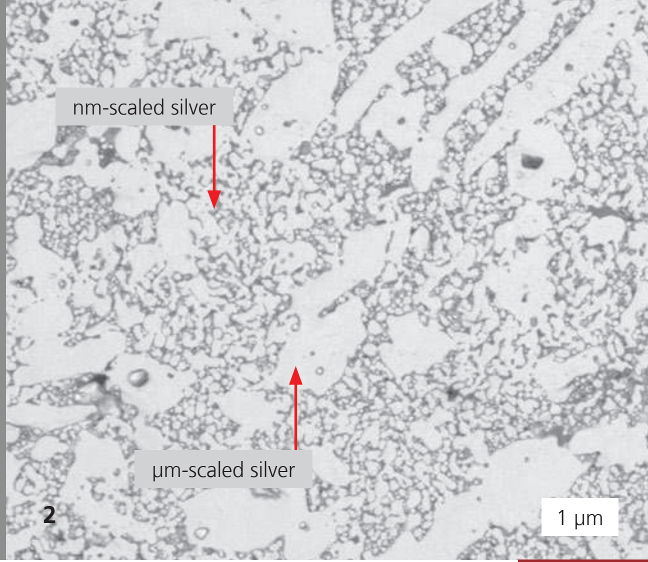

2

LOW-TEMPERATURE METALLIZATION PASTES FOR HETEROJUNCTION SOLAR CELLS

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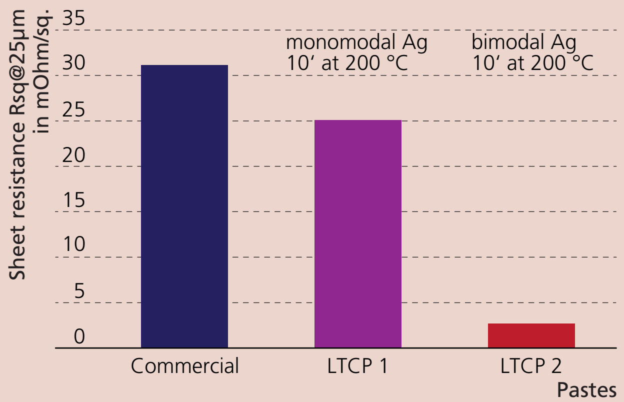
A promising cell concept for environmentally friendly, efficient generation of solar power in Germany is the heterojunction solar cell (Figure 1). This concept is predicted to gain market shares of up to 10 % with stabilized cell efficiencies of 24 % by the year 2026 [1].

In this solar cell, the doped semiconductor layers of the emitter and the passivation layer are generated by vaporization of amorphous silicon. The amorphous Si layers only survive a maximum temperature of 200 °C. Thus, silver pastes capable of being cured at 200 °C were developed for front-side metallization (Figure 1). These pastes are based on solvent-polymer combinations (so-called binders), which can be cured thermally and filled with functional phases. Silver is the most commonly used metal for front-side metallization of solar cells.

Due to the low process temperature, the conductivity of the polymer-silver composites is usually generated not through sintering, but rather via percolation paths created by the metal particles. For a minimum layer resistance, high solids contents in the pastes are necessary. This is accomplished through binder systems with suitably adapted compositions and rheologies. With a monomodal silver powder, sheet resistances of 25 mΩ/sq in the cured layer are obtained (middle column in diagram below).

A further increase in conductivity of the polymer conductive phase can be achieved through use of bimodal silver powder mixtures in which nanosilver is added to the conventional silver. Thanks to the unique properties of nanoparticles, the tap density of the metal phase can be increased and sinter necks can be created to form conduction paths, in addition to the

Sheet resistance as a function of paste composition for cured polymer conductor layers



percolation paths (Figure 2). The sintering activity of the nanoparticles depends on both the particle size and the surfactants used in the preparation of the nanoparticles. The surfactants additionally influence the dispersibility of the nanoparticles in the binder vehicle. This affects the solids content and, with it, the resistance of the cured layer. With an optimized surfactant chemistry, sheet resistances of 2.7 mΩ/sq can be reached.

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[1] International Technology Roadmap for Photovoltaic (ITRPV), 7th edition, 2016, version 2, pp. 30–32.

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1 *Heterojunction solar cell.*

2 *Cross section through a conductor layer.*

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