Photovoltaic Materials

NS 33-551 Hot Melt
Front Contact Silver for SiN Passivated Solar Cells

Description: NS 33-551 is part of a specially designed silver conductor system that does not require drying. By eliminating the drying processes of conventional pastes, Hot Melt compositions offer higher throughput rates, increased productivity and improved yields. Hot Melt pastes are solid at room temperature, but when resistively heated above their melting point, the ink will screen print similarly to a conventional thick film paste. Unlike conventional pastes, once the paste is transferred to the solar cell, the ink instantly resolidifies and is ready for the next printing sequence. During the printing sequence of the front silver grid pattern, this unique property of the Hot Melt ink system improves the aspect ratio and reduces shading, which contribute to a higher cell efficiency than can be achieved with conventional screen printing materials.

NS 33-551 is a specially designed silver paste for contacting p/n^{+} type crystalline silicon solar cells passivated with SiN_x coatings with thicknesses between 750–900 A^{o}. When fired, this screen printable ink yields very low bulk and contact resistivity, which results in high a Fill Factor and energy conversion efficiency. During the firing process the glasses and additives contained in the inks react with silicon nitride to form a low resistance contact while providing good adhesion to the wafer and excellent solderability. The ink provides very good electrical contact to n+ surfaces passivated with SiN_x. NS 33-551 is able to contact emitters from 40 to 65 ohms/square. The conductor is compatible with all Ferro rear silver pastes as well as lead free and low bow aluminum pastes. NS 33-551 also has the ability to fire through TiO_2 ARC.

Typical Properties

	NS 33-551
Viscosity (Pa·s)[1]:	70–140
Solids Content:	86.0–90.0%
Fineness of Grind:	< 14/11 μm
Printed Thickness:	35–50 μm
Fired Thickness:	20–30 μm
Line Resolution:	80–125 μm
Resistivity[2] (milliohms/square):	< 2.0
Drying Profile[3]:	No drying required
Firing [3]	810–940°C, < 1–3 seconds
Recommended Thinner	None; solid at room temperature

All properties are target values and are not meant to represent product specifications

Notes:
[1]Viscosity as measured on Brookfield model HBT cone/plate viscometer; 9.6 reciprocal seconds, 1.565°cone, 80°C.
[2]Milliohms/sq. at 25μm.
[3] Recommended set points °C in infrared firing furnace.

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Product Advantages:

- RoHS-compliant[4]
- Cadmium Free[5]
- Hot Melt reduces cycle times, VOCs, wafer handling/breakage & floor space
- Forms excellent contact on 40–65 Ω/square emitters
- Reduced contact resistance & higher aspect ratio yield greater power output
- Wide processing window, fires through SiN & TiO_2 ARCs

Processing Recommendations

Printing: The screen and squeegee need to be heated to temperatures of 80–85°C prior to printing. The temperature of the stage or nest used to carry the silicon wafer should also be controlled to achieve optimum results.

Screen: 250–325 mesh screen with a 20–25 μm emulsion thickness is recommended. Wire diameter is 20–25 um with a mesh orientation of 45°.

Drying: No drying is required, as the paste instantly resolidifies after transfer to the solar cell.

Soldering: Recommended soldering conditions (ribbons) are 290°C for 96.5Sn/3.5Ag; and 220°C for 62Sn/36Pb/2Ag.

Firing: An Infrared fast process furnace with three or more firing zones and belt speeds of > 200 inches per minute is highly recommended, although the product may be fired in a variety of furnaces with belt speeds > 120 inches per minute. Optimum firing conditions must be established by the customer based on the cell configuration, thickness, and manufacturing process. Peak set point temperatures between 810–940°C with a dwell time above 700°C ranging from > 1 to 3 seconds is typical.

Compatibility: Ferro has tested this material according to the recommended processing conditions described here, however, it is imperative that customers evaluate the material in their manufacturing process and conditions to insure suitability for their intended use. Ferro technical personnel can help facilitate testing, and can assist with integration into customer manufacturing processes.

Thinning: Thinning is not recommended, since the paste is solid at room temperature. The viscosity of the ink may be adjusted by controlling the temperature of the screen.

Paste Storage & Shelf Life: The paste should be stored in tightly capped containers in a cool (5–30°C) dry place away from direct sunlight. When properly stored, unopened material will have a shelf life of up to 6 months.

Notes:
[4] Complies with EU Directives on Restriction of the use of Hazardous Substances (RoHS; 2002/95/EC) and Waste from Electrical and Electronic Equipment (WEEE; 2002/96/EC). Current exemptions allow lead contained in the glass system of thick film materials used in electronic components. In anticipation of future amendments and more stringent environmental regulations, Ferro continues to expand its range of Lead Free[5] materials.
[5] Initial product composition was certified by SGS laboratories to be below the detection level for cadmium. This conductor paste is not routinely analyzed for cadmium content and is not the basis for product specification or warranty.

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