Development of a copper paste for crystalline silicon solar cells

Replaces silver pastes and accelerates the reduction in the cost of high-efficiency solar cells

We have developed a copper paste to replace silver pastes for crystalline silicon solar cells. Our developed copper paste features an addition of a low melting point (LMP) alloy. After melted, the LMP alloy can diffuse into the inside of copper particles as well as the spaces between copper particles so that it may cover the whole copper surfaces forming metal bonding with copper. It can be expected not only to enhance the conductivity, but also to prevent oxidation of copper and migration of copper atoms into substrates. The inexpensive copper paste achieves a performance nearly equivalent to those of conventional silver pastes, i.e., low resistance (3×10^{-5} Ω•cm) and low contact resistance (5.3×10^{-4} Ω•cm^2). In addition, by controlling the composition of the alloy paste, these technologies can be applied to the formation of wiring and electrodes for various cell structures, including flexible displays and sensors.

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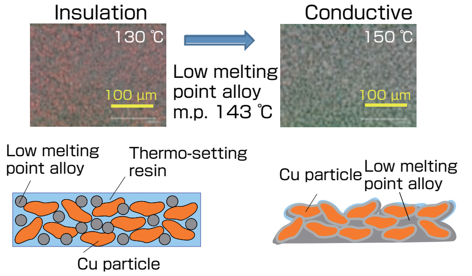
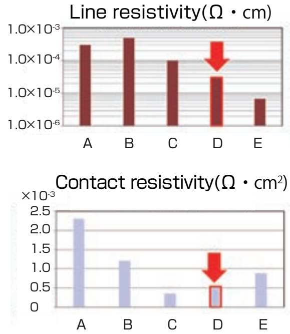


Optical micrographs and schematic description before and after melting of the low melting point alloy



Comparison of resistivity with the copper paste we developed
Commercially available copper paste: A, B, C
Developed copper paste: D
Commercially available silver paste: E

Electrically induced giant magneto-resistance from non-magnetic phase-change memory

Magneto-resistance ratio of over 2,000 % at room temperature

We have developed a new phase-change memory device with magneto-resistance ratio of more than 2,000% using an artificially designed superlattice of Ge-Te and Sb-Te crystalline alloy sub-layers. Even without any magnetic element, it was found that the superlattice has a giant magneto-resistance, which is probably induced by its topological invariance with a special band structure known as Dirac cone. The discovery of the magneto-resistance from a non-magnetic phase-change superlattice may have the potential to combine a phase-change memory and a magnetic memory together into one multi-functional memory device in the future.

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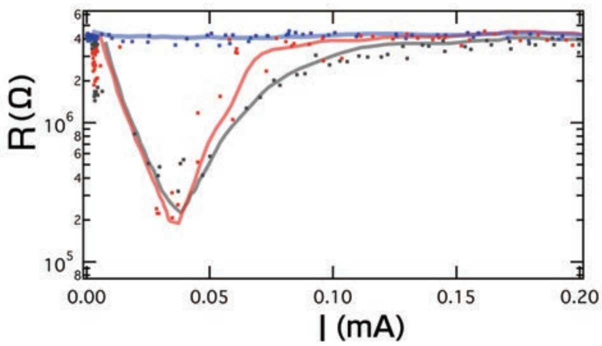

Switching curves of the superlattice phase-change memory device
The curves are initial switching (red), switching under a magnetic field (blue) and a switching after the magnetic field is removed (grey). The magnetic field is 0.1 T in plane.