Conductive copper paste is a promising material for use in electronic devices, replacing silver or other metal pastes, for its high conductivity and solderability as well as its low electro-migration and cost. However, the high sintering temperature and need of an inert sintering atmosphere limit the application of copper paste from commercialization. In this project, a copper thick film paste is developed using copper particles with bimodal size distribution to reduce the sintering temperature. The impact of sintering temperature profile and the effect of using glass frits as an additive are studied to enhance the electrical performance of the sintered copper film.

Copper pastes with a single copper particle size – 0.05, 0.1, 1 and 10 µm – were prepared. At 500°C sintering temperature, Copper pastes with 50 nm nanoparticles exhibited the best morphology and electrical performance than pastes made up of particles of other sizes. At 950°C sintering temperature, the copper pastes with particle size at 0.1 and 1 µm possessed the lowest sheet resistance. Then, bimodal copper paste made up of 1 µm and 50 nm particles in various weight ratios were prepared. At a sintering temperature of 500°C, the best result occurred at 33.3wt% of copper nanoparticles (i.e. W_{1\mu m}:W_{50nm} = 2 : 1) where the volume resistivity of the sintered film was 6.27×10^{-8} \, \Omega \cdot \text{cm}.

Next, the effect of peak sintering temperature and sintering time for the best bimodal paste was studied. The sintered copper film possessed best performance at the peak temperature of 500°C and the bulk resistivity reached 4.43×10^{-8} \, \Omega \cdot \text{cm} when the sintering time was 10 min.

Finally, bimodal copper pastes with glass frits as an additive were studied. It was shown that with the aid of these glass frits, the adhesion strength between the copper film and the alumina substrate was elevated while the increase from 4.43×10^{-8} \, \Omega \cdot \text{cm} to 9.10×10^{-8} \, \Omega \cdot \text{cm}.