Roles of Conductive and Dielectric Inks in Printed Circuitry

Conductive and dielectric inks are two categories of functional inks used in printed circuitry, both of which can be used in a wide array of applications and markets such as membrane switches for white goods, flexible displays, automotive heating elements, medical wearables using flexible printed circuits, and much more. Both conductive and dielectric inks perform distinct roles in the construction of printed circuits, so it's important to understand the differences.

Conductive Inks

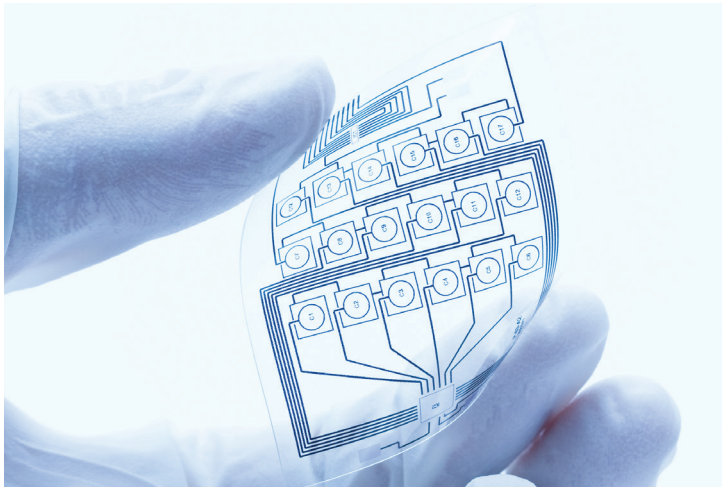
Inks formulated with characteristics of high conductivity are used as the primary circuitry traces that carry the electrical current to all necessary components on a printed circuit board or part. The required strength of said conductivity varies depending on the nature of the application, and the price point of the ink tends to increase as conductivity does.

These conductive inks can be formulated from a variety of different resins and solvents, including UV-curable, water-based, and solvent-based systems. Each are designed to perform under the particular conditions they may face in a given application/ manufacturing process. Examples of these conditions include cure temperature, printing process, or the type of base substrate it must adhere to – often some type of heat-stabilized PET.

The other key element in conductive ink formulations is the conductive pigment used. The two pigments most used in the market are silver and carbon. Silver inks provide best-in-class conductivity as well as better longevity than similarly conductive metals. Carbon inks are more resistive than silvers, but they also have great longevity and are more cost-effective. Silver and carbon inks can be blended to fine tune resistivity levels to best suit an application's requirements, as many may applications do not require the high level of conductivity that a silver ink would yield on its own.

Dielectric Inks and Coatings

Dielectric inks and coatings play a vital role as an insulator in printed circuits and perform a number of unique functions. These nonconductive inks can act as a coating to provide environmental protection to the circuit's printed conductive traces. They can also be used to stop circuit shortages by cutting off the electric current from reaching certain areas. Dielectric inks make multi-layered printing and circuitry crossover possible by acting as nonconductive dividers, allowing for the construction of smaller, more complex circuitry without issue.



Furthermore, dielectric formulations can minimize silver migration in instances where there is current draw or moisture present. Silver migration is a common phenomenon that occurs in the printed electronics industry where silver ions move between two printed silver traces with voltage potential, usually when there is an electrolyte such as moisture present within the circuit. This will cause the circuit to short. However, if constructed effectively, coating silver traces with inert dielectric inks can significantly reduce the chance of silver ions migrating even in the presence of moisture.

Tekra Tek Tip
Roles of Conductive and Dielectric Inks in Printed Circuitry

Most dielectric inks and coatings are designed to be UV-curable due to certain enhanced properties these formulations possess. UV-curable dielectrics are made up of 100% solids, meaning they do not contain any solvents or water which could evaporate while curing. This ensures that they will maintain their original shape and viscosity throughout the entire curing process. UV-curable dielectrics can also be crosslinked to the printed circuit, a practice that chemically bonds the coating to the surface which makes the resulting protective barrier more resistant to certain environmental and chemical factors. UV-curing systems are also known for faster processing speeds than thermal curing, which is an alternative method.

Tekra offers a wide range of LOCTITE® silver and carbon inks and complementary dielectric coatings from Henkel Electronic Materials. To learn more about our inks portfolio, click here.

For product recommendations, call Tekra at 1-866-448-3572 to discuss your application.