Technical Data Sheet Nink-1100

NINK-1100 is an aqueous suspension of carboxyl functionalized singlewall carbon nanotubes. It is formulated for inkjet printing of conductive traces on many substrates or spraying. Nink1100 is compatible with Fuji's line of Dimatix printers, and have been used with thermal inkjet print heads from HP. Binder free, the nanotubes dry to a network that is conductive, but not transparent.

Specifications

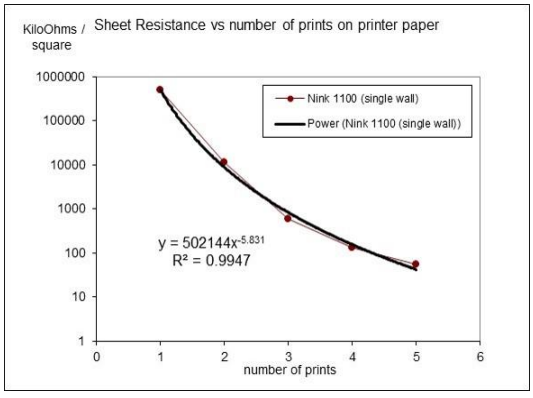
Nanotubes:	PD1.5L1-5-COOH (SWNT- 1.5nm diameter, 1-5 micron length, carboxyl functionalized)
Concentration	2 g/liter in water
Surface tension	30 dynes/cm
Contact angle	25-30 degrees
Viscosity	~3cP
Surfactant conc.	<1 Wt%, nonionic
pH	Stable between 5-9

Printing with Nink 1100

While compatible with many substrates, we developed and tested Nink 1100 with both transparency film and ordinary notepaper. Nanotubes, being difficult to suspend at high concentration without building viscosity, must be kept at 2g/liter or below for inkjet printing. The carboxyl groups dissociate in water, leaving each nanotube with a negative surface charge from COO^-. The negative charge keeps the nanotubes isolated and free from agglomeration. Repeating the printing process will build thickness and increase the conductivity of the print.

Electrical properties

ASTM D-254 covers the measurement of sheet resistance for coatings. NanoLab uses a 1" square test fixture, consisting of two brass contacts, separated by a 1" square insulator, as shown below. The fixture is firmly held against the printed sheet, and resistance is measured using a Keithley Sourcemeter 2400. Our sheet resistance jig is pictured below. Also below, is a plot of the sheet resistance (ohms/square) of the carbon nanotube deposit printed on notebook paper as a function of the number of prints, in this instance a rectangle 1.5x1". On notebook paper, the first print results in a deposit that is below the percolation threshold, partially due to wicking of the nanotubes into the porous paper network. Electrical resistance drops with the number of additional prints, as the layer of nanotubes increases in thickness. Depending on the printer uniformity, fine features may become blurred by multiple prints.



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Tips and Tricks

Printing with a Nink is improved by degassing of the ink. This is best done right before filling a cartridge or print head. The volume of Nink to be used is placed in a beaker, which is then placed in a bell jar or vacuum chamber (pictured at right) and evacuated to remove entrained air. This improves the printability of the ink.

Also, many print heads, especially thermal ink jet heads, need to be completely full. They will not work well if there is an air pocket within the cartridge. At the nozzle, the ink is rapidly heated so that a drop is ejected. Gas bubbles in the fluid are compressible, and reduce the output. We used the HP45 cartridges successfully for many years, but the design was discontinued and there are few printers left that use this cartridge. Those could be refilled, plugged, and evacuated to result in a reliable Nink cartridge. Newer cartridges have refill-defeat devices and demand more involved refilling procedures. Youtube is a good source for refilling instructional videos for your printer and cartridge combination.

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