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Conductive Ink Based on Nano-Silver and Its Applications in Printed Electronics

納米銀导电墨水及其在印刷電子中的應用

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Jan.13, 2023

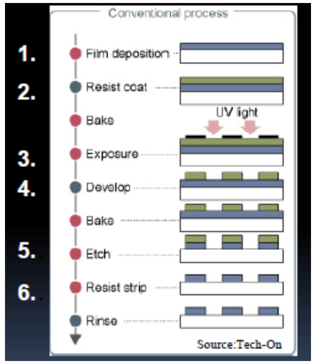
印製電子的研發動機

高成本

高性能

傳統電子產品

- 複雜的裝備過程
- 小尺寸
- 剛性基板
- 高集成度
- 快速

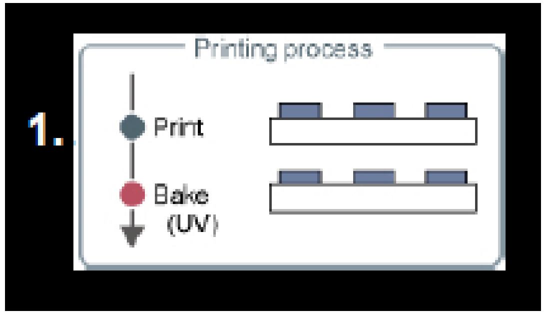


低成本

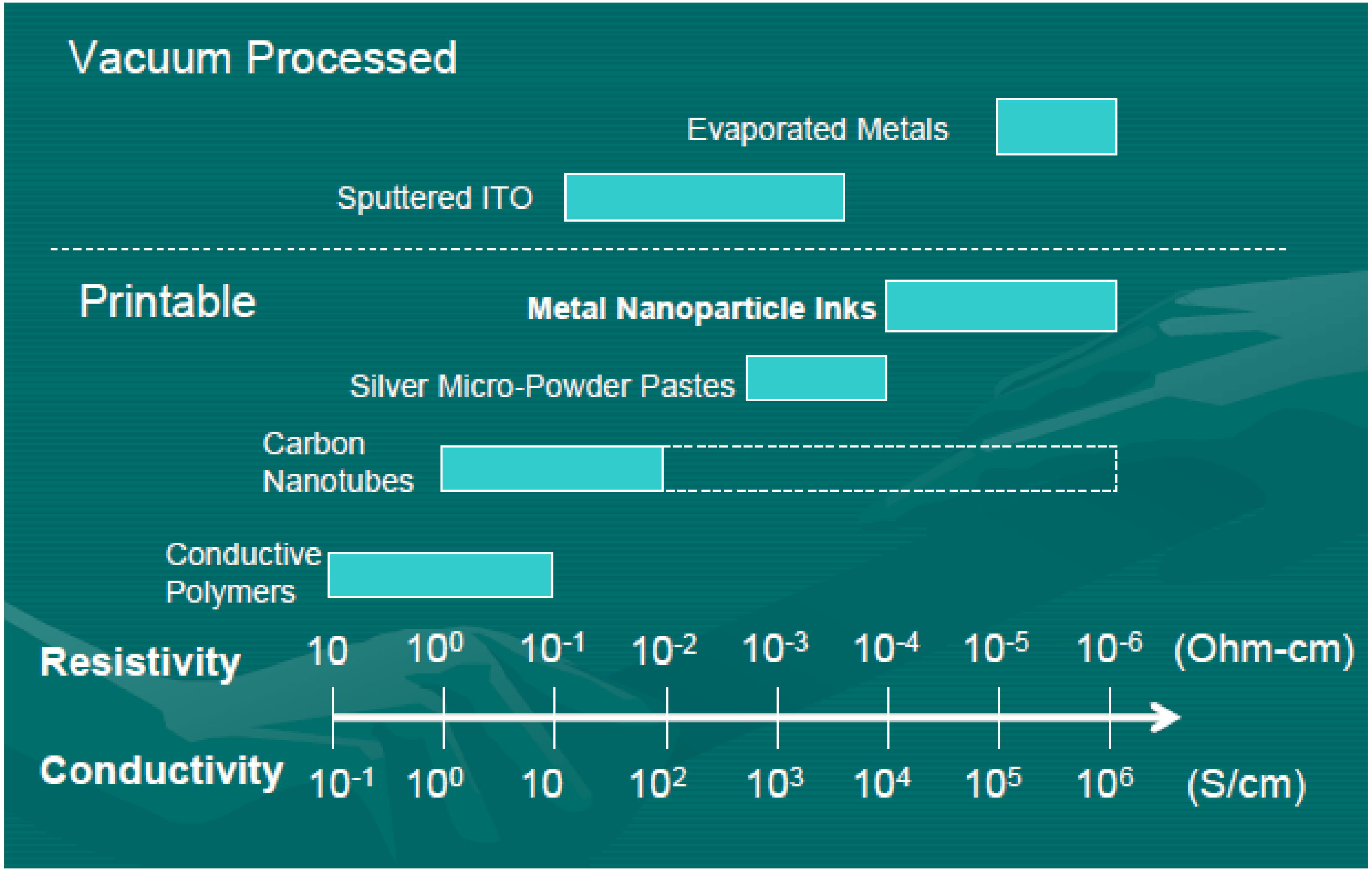
低性能

印製電子產品

- 簡單快速的製備過程
- 大尺寸
- 柔性基板
- 低集成度
- 慢速



印刷導電材料比較



在所有印制材料中， 金属纳米颗粒具有最佳导电性

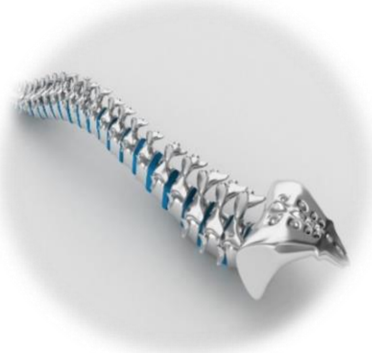
納米銀

銀單質

❖ 貨幣
❖ 抗菌材料

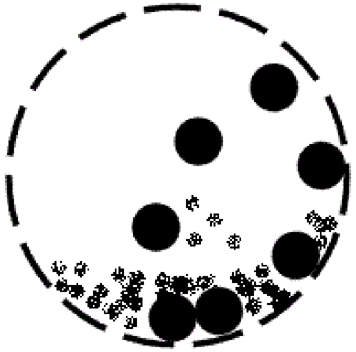
納米銀

❖ 小尺寸效應
-- <100 nm
--低熔點 約 100-150 ℃
❖ 表面效應
-- 抗菌效果 X20-30 倍

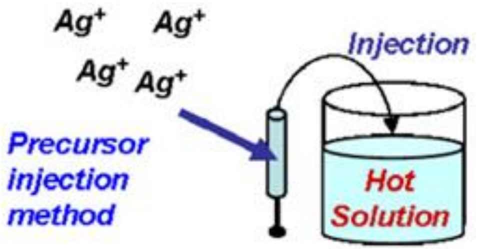


納米銀的合成及現狀

製備方法

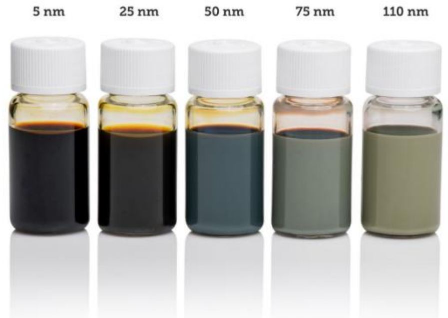


機械球磨法



化學還原法

市面上的產品

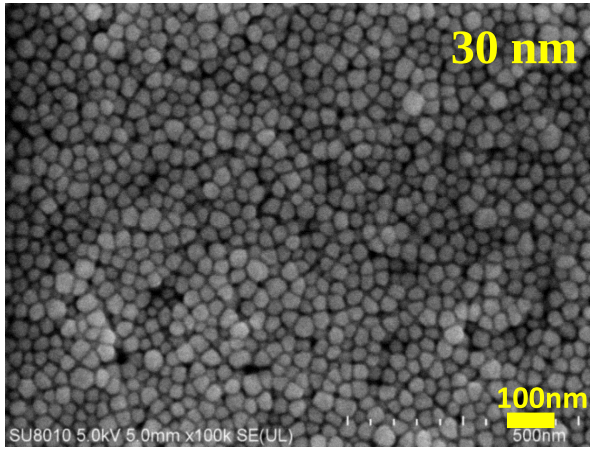


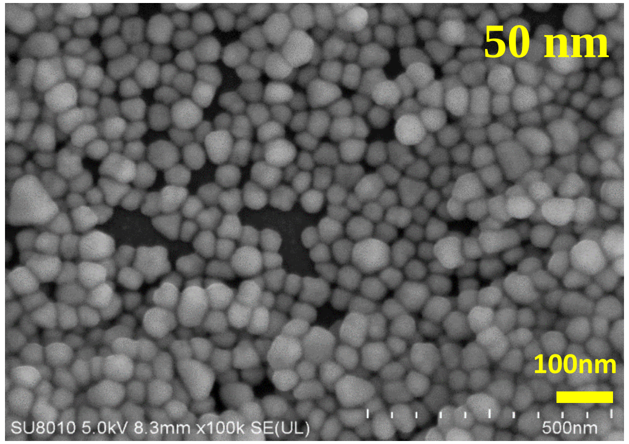
優點：便宜
缺點：易團聚，難分散

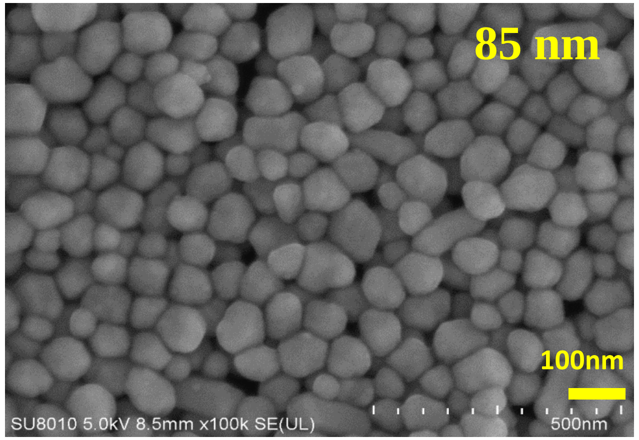
優點：分散性好，可直接使用
缺點：產量小，濃度低，價格高

納米銀的批量合成

可根據不同應用要求合成不同大小的納米銀

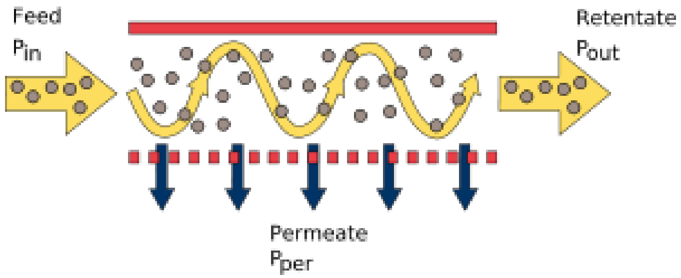






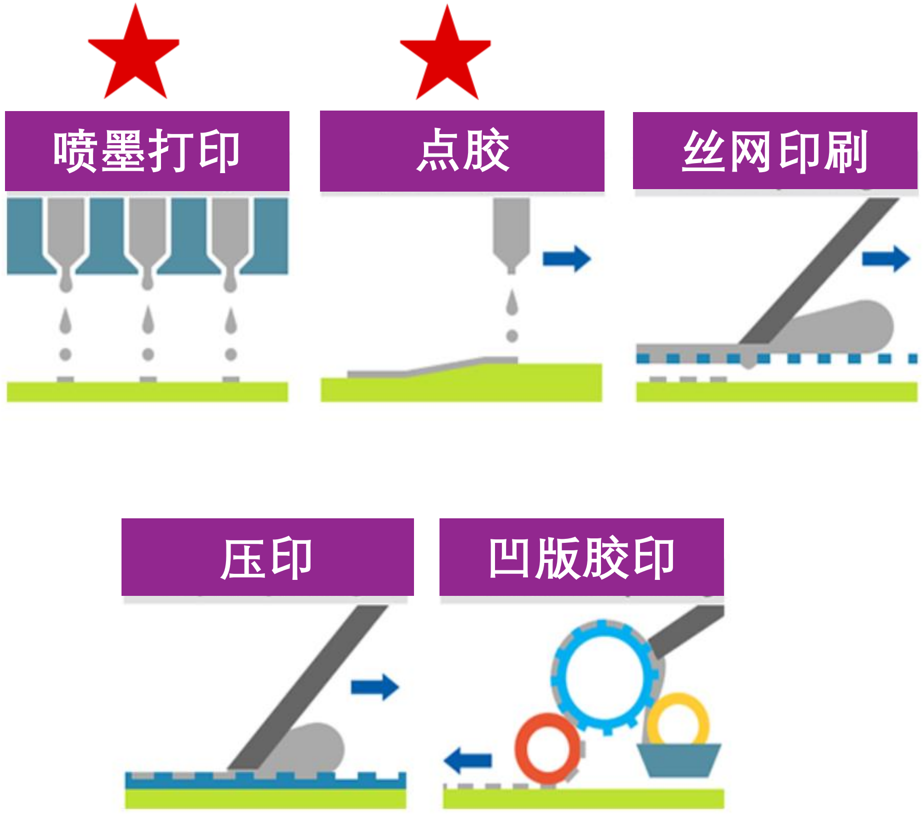
可調節顆粒大小的合成工藝

大批量連續提純過程，有效降低納米銀成本



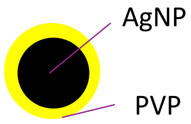
高效、大批量的納米銀提純工藝

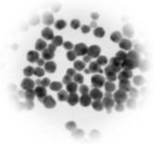
配方專家



優勢1

PVP 包覆，分散效果好， 有效解决纳米银团聚问题。





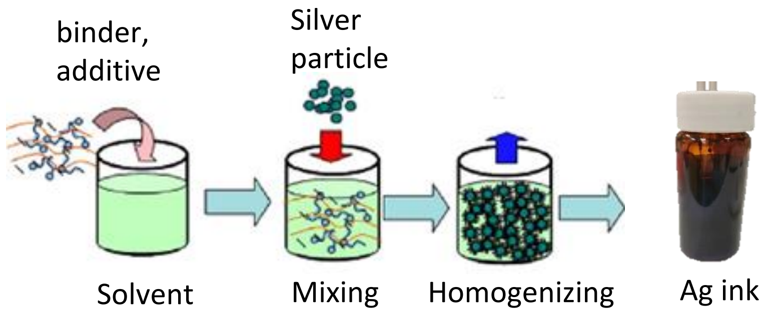
優勢2

根據不同應用以不同濃度分散在不同溶劑中，使用时将溶剂置换。

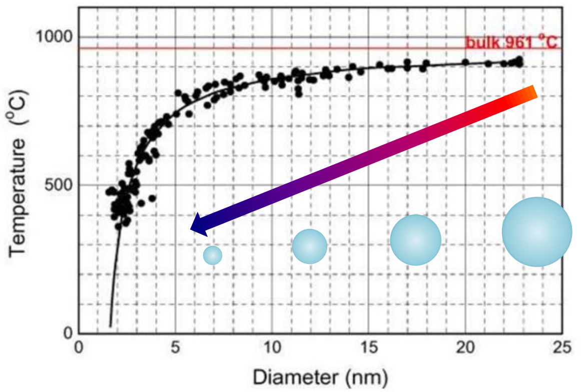
優勢3

根據不同產品性能需求，使用不同配方以滿足客戶需求。

數字打印納米銀油墨的製備及燒結

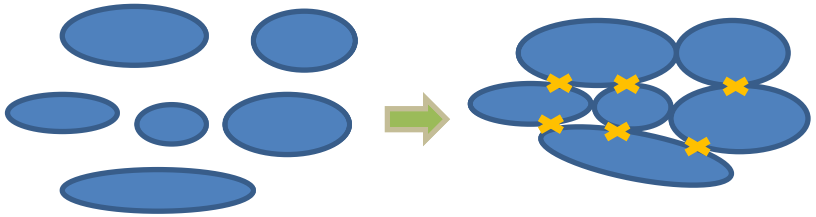


油墨的製備過程



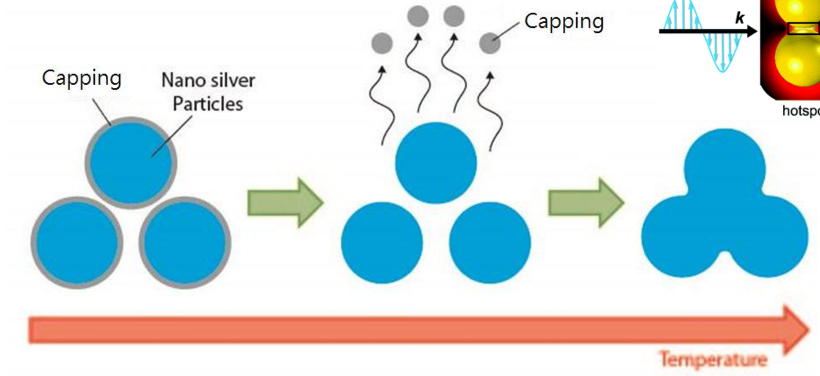
*Ph. Buffat and J-P. Borel, Phys. Rev. A13（1976）2287

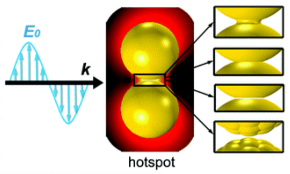
納米銀的熔點隨著粒徑減小而降低



微米銀的固化:

- ➢ **微米銀顆粒間的物理接觸**
- ➢ **導熱率、電導率有限**





納米銀的燒結:

- ➢ **低燒結溫度下，顆粒間形成熔融納米銀接合點**
- ➢ **形成優良的導熱和導電路徑**

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納米創意無止境

噴墨打印技術

Fuji Film Dimatix Inkjet printer

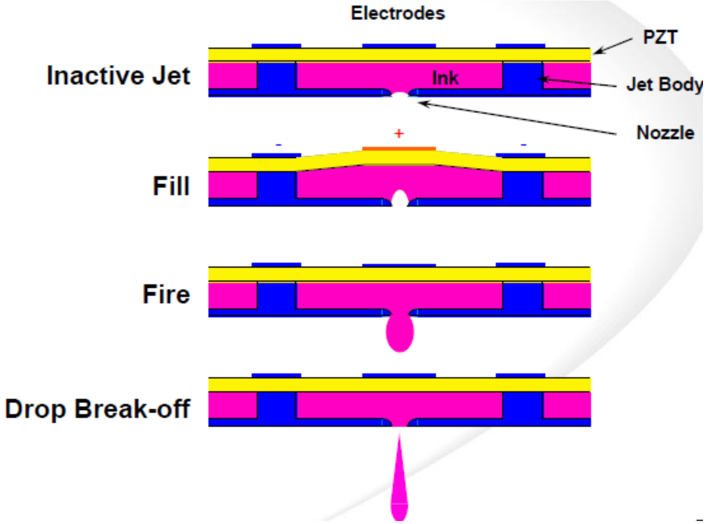
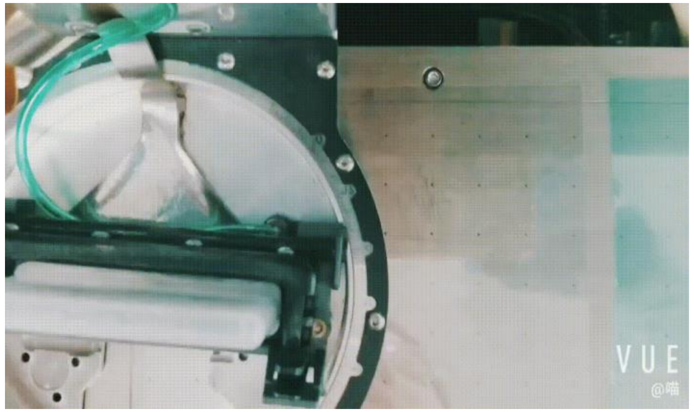


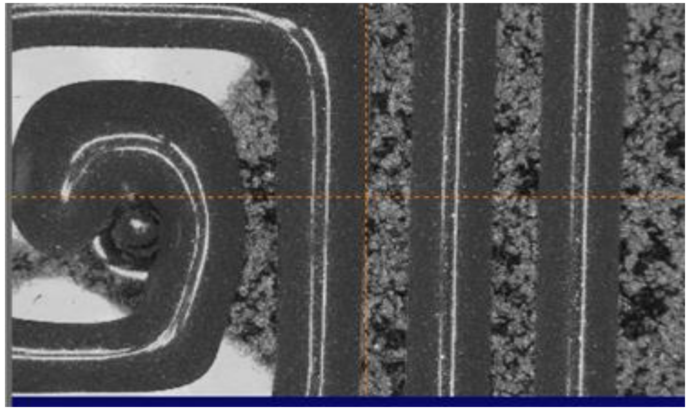
表 1　分辨率与墨滴尺寸的关系

序号	分辨率(dpi dots per inch)	墨滴尺寸要求(PL)
1	300	≤80
2	600	≤40
3	1 200	≤4
4	2 400	≤2

優勢:

- 數碼打印， 打印圖樣不受限
- 打印精度高 （高至5080 dpi）
- 非接觸式打印
- 技術易於實現工業化



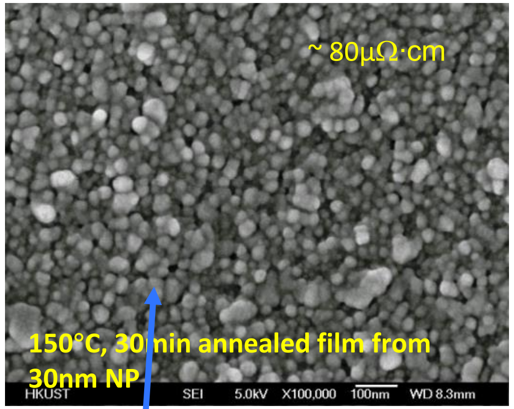


納米銀墨水的打印過程

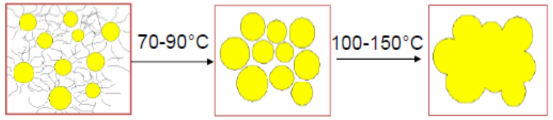
清潔基材

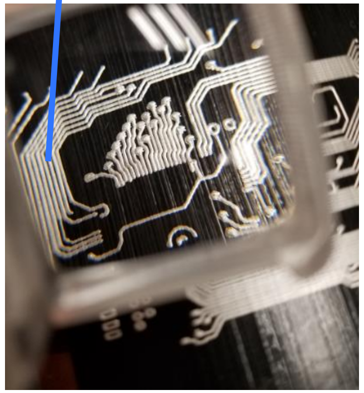
PET/PI/FPC 基材

等離子清洗



打印及固化





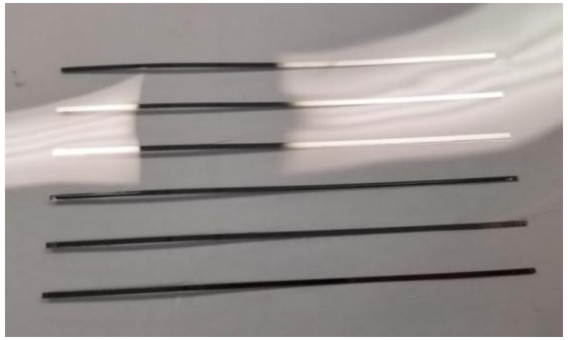
納米銀墨水

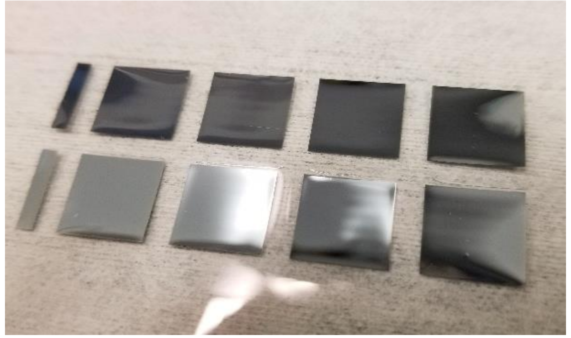
噴墨打印

熱處理
100-150°C for 5-30 minutes

NAMI 納米銀墨水應用案例

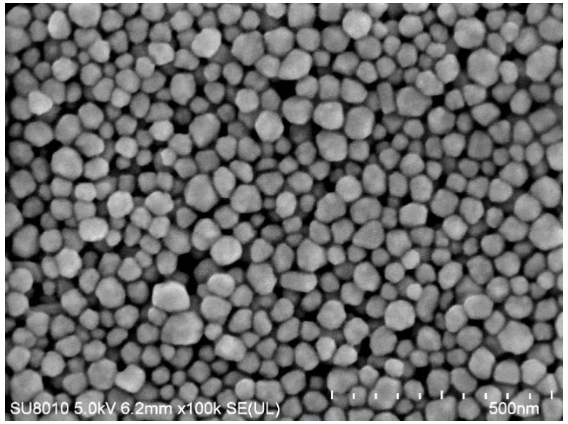
- ❑ NAMI 納米銀墨水(20-40wt%)
- ❑ 使用 Dimatix 2830 噴墨打印機打印
- ❑ 固化條件： @ 150 ℃, 30min



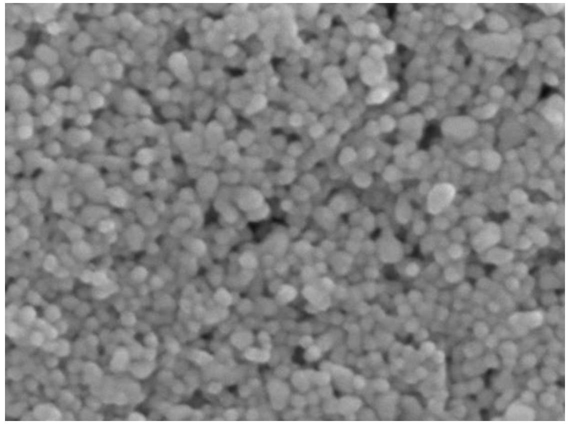


120-150℃下固化成膜，具有金屬光澤及良好的導電性

- ✓ 低溫燒結后，顆粒與顆粒之間連接，形成導電通路
- ✓ 面電阻低至0.15 Ω/□.
- ✓ 形成的導電膜與基材之間有良好的粘接性。可靠性高



低溫燒結前

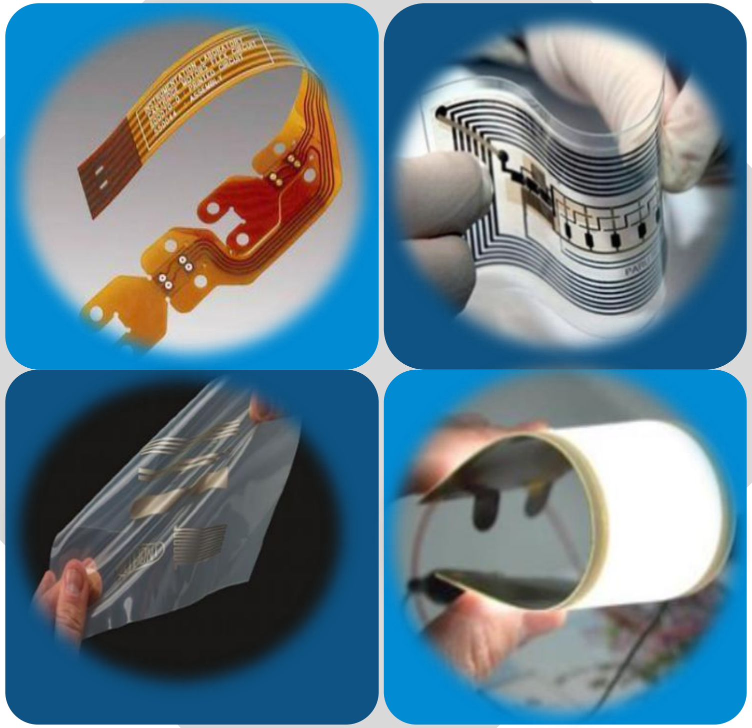


低溫燒結後

噴墨打印導電墨水技術的應用

柔性印刷电路板（FPCB）

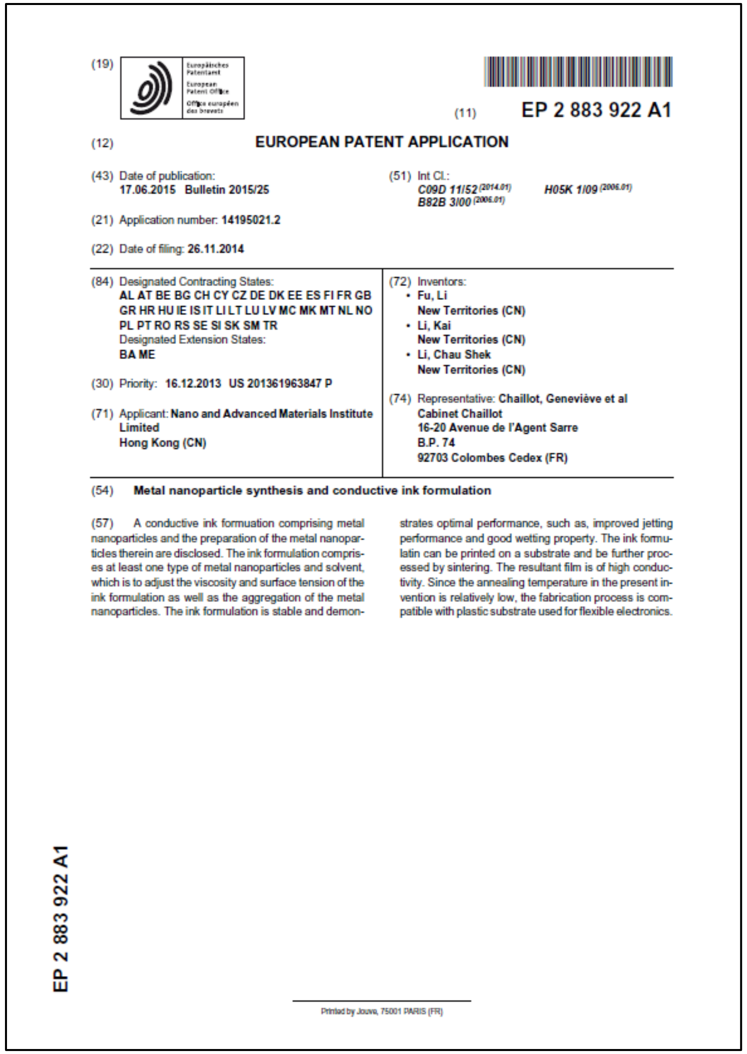
无线射频识别标签（RFID）



可拉伸彈性電子器件

柔性電子器件（OLED）

專利技術成果



(19) Europäisches Patentamt / European Patent Office / Office européen des brevets

(11) EP 2 883 922 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.06.2015 Bulletin 2015/25

(51) Int Cl.:
C09D 11/52 (2014.01) H05K 1/09 (2006.01)
B82B 3/00 (2006.01)

(21) Application number: 14195021.2

(22) Date of filing: 26.11.2014

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(30) Priority: 16.12.2013 US 201361963847 P

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(54) Metal nanoparticle synthesis and conductive ink formulation

(57) A conductive ink formuation comprising metal nanoparticles and the preparation of the metal nanoparticles therein are disclosed. The ink formulation comprises at least one type of metal nanoparticles and solvent, which is to adjust the viscosity and surface tension of the ink formulation as well as the aggregation of the metal nanoparticles. The ink formulation is stable and demonstrates optimal performance, such as, improved jetting performance and good wetting property. The ink formulatin can be printed on a substrate and be further processed by sintering. The resultant film is of high conductivity. Since the annealing temperature in the present invention is relatively low, the fabrication process is compatible with plastic substrate used for flexible electronics.

EP 2 883 922 A1

Printed by Jouve, 75001 PARIS (FR)

NAMI

- ✓ 納米銀批量合成及低成本的提純技術
- ✓ 適用於不同印刷領域的油墨配方
- ✓ 在客製化導電銀墨水、導電銀漿、碳漿方面有著豐富的經驗

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