



# Copprint



Copper pastes that outperform silver – make the switch.

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# Silver vs. Copper

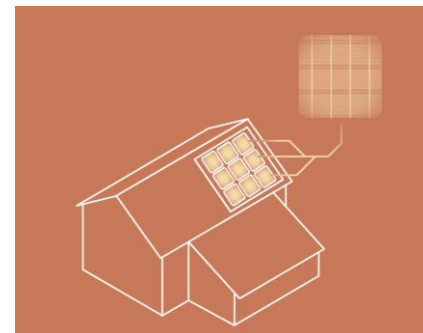
Conductive silver inks are used since 100 years ago for many applications:

E.g. Photovoltaics, Membrane switches, sensors, heaters and more

Silver is expensive and recently **surged >60%** relative to its 5-years average.

The cost of silver is a significant ingredient in various products:

- 10-30% of PV modules.
- >80% of membrane switches, flexible heaters, sensors.



## Copper is a great alternative

Raw material comparison:	Silver	Copper	Copper vs Silver
Price per Kg	\$850	\$8	100X cheaper
Conductivity	$1.59 \times 10^{-8} \Omega m$	$1.68 \times 10^{-8} \Omega m$	5% less conductive
Carbon footprint	155 kgCO <sub>2</sub> /kg	3.97 kgCO <sub>2</sub> /kg	40X better
Max level in drinking water (EPA)	0.1 mg/litter	1 mg/litter	10X less toxic

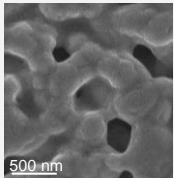
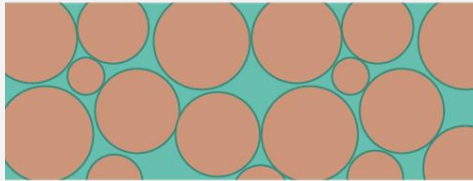
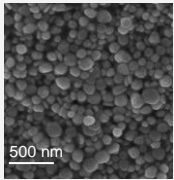


For many years people tried to print copper and failed

Motivation: raw copper is 100x cheaper than silver

Problem: **Copper oxidation** prevented conductivity

Copper Oxidation, Impeding Conductivity



Copprint Chemical Rapid Sintering

## The Innovation

Copprint overcome the copper oxidation using a patented chemical sintering agent:

- Rapid low temperature Sintering which Prevents Oxidation
- Highly Conductive results
- Low Cost, Efficient (No Material Waste)
- Substrate Freedom
- Standard “Air” Printing Process & Equipment

# Copper inks that outperform Silver

Anything you can print with conductive silver inks,

**Copprint can do better. Faster.**

**At a fraction of the cost.**

Copprint screen-printing pastes for a range of substrates:

LF-300 – paper substrate - Released

LF-350 – PET substrate – Released

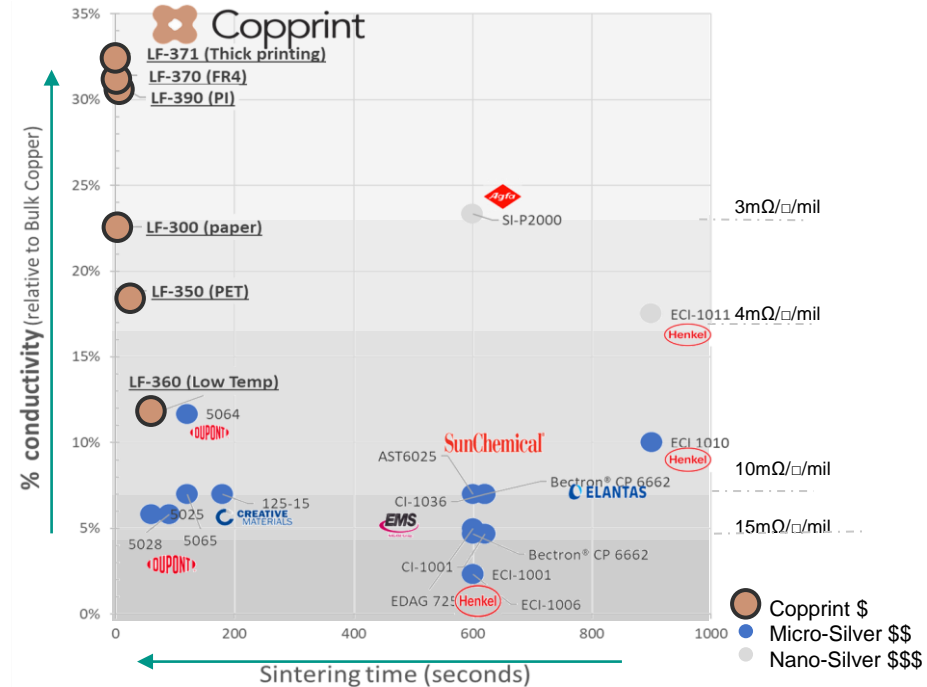
LF-360 – Low temp for PET/PC – Beta 

LF-370 – FR4 substrate – Released


LF-371 – Thick printing (FR4, PV, Glass, PI) - Released

LF-390 – PI substrate - Released

Additional substrates: Glass, Alumina, Aluminum, PC, PEN, CFRP, Tesline

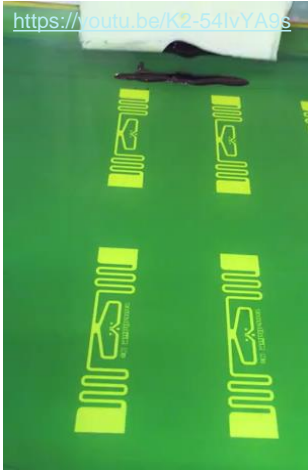


## Copprint's pastes for various substrates

Paste	Substrate	Viscosity (cPs)	Sintering Temp	Processing	Sheet resistance $m\Omega/\square/25\mu m$	Solid content
LF300	Paper	7,000	280-300	R2R	<3	83%
LF350	PET	6,000	200	S2S	<4	81%
LF360	Low-temp PET, PC 	15,000	160	S2S + R2R	<6	88%
LF370	FR4/Alumina/Glass/Aluminum..	9,000	240-300	S2S + R2R	<2.3	88%
LF371	FR4/Alumina/Glass/Aluminum..	30,000	240-300	S2S + R2R	<2.3	90%
LF390	PI	15,000	240-300	S2S + R2R	<2.3	88%

# Really Simple Fabrication (Prototyping, Short Runs)

1) Print



Screen printing in few seconds

2) Dry



Drying oven/conveyor/UV  
Oven/Conveyor: 30-120 sec at 70-150°C  
NIR/UV lamps – 1-5 seconds

3) Sinter



Standard hot-press/contactless Laminator  
160-300°C  
Laminator – 3-12 sec dwell time  
Hot-press – 30-120 sec

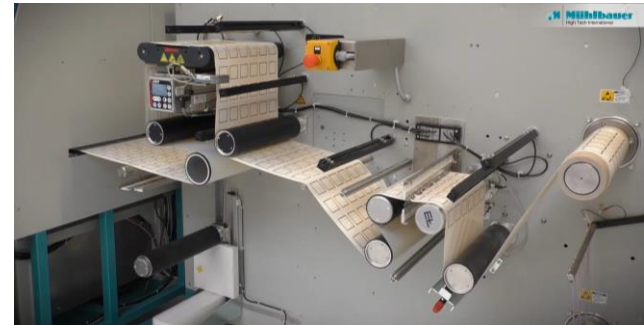
# Muhlbauer APS tailored to Copprint ink

## Industrial Scale Antenna Printing Solution

1) Print

2) Dry

3) Sinter



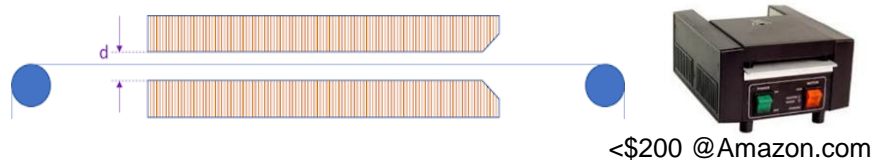
## Snap heating is required for sintering

### Contactless laminator:

Simple and robust system for S2S and R2R implementation.

Temperature 170°-320°C

Typical dwell time – 3-12 seconds.



### Simple hot-press (Manual or pneumatic):

Simple and robust system for S2S - Temperature 160°-300°C

No significant pressure is required – just efficient heat transfer.

Sintering of >30 sheets in parallel in a single press was tested



Photonic sintering – Reported to be working well on R2R



## Durable printed patterns on multiple substrates

- ✓ Paper, PET, PI, Teslin, Aluminum, Alumina, FR4, Glass, PV cells
- ✓ Accelerated durability tests (90°/60%, 85°/85% tests)
- ✓ Excellent adhesion
- ✓ Crosshatch test – 4-5b
- ✓ Bending tests (25x rolls over 5mm radius rod, <10% change).
- ✓ Solderability



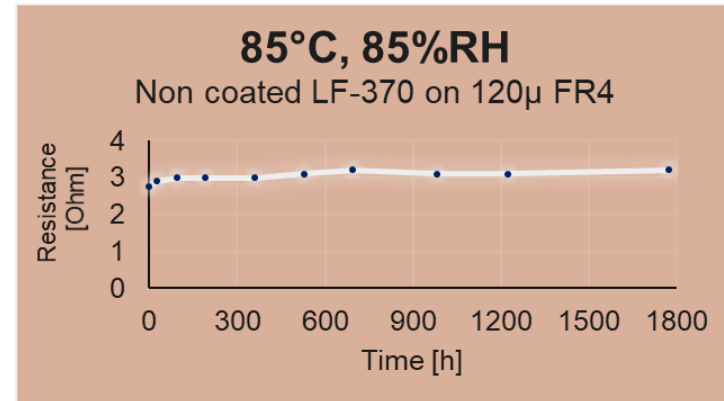
<https://youtu.be/JedfsK63tXs>



LF-350 on PET

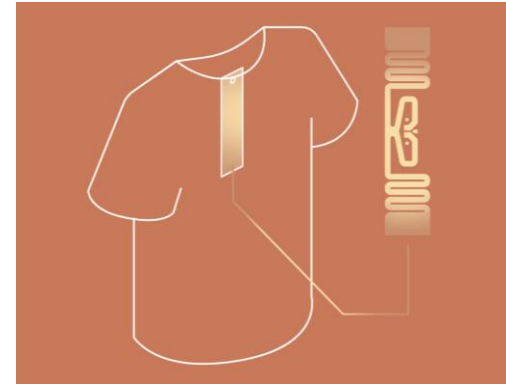


LF-370 on anodized aluminum



# Example 1 - Printed RFID antennas on paper

- RFID antennas are the simplest and largest by number PCBs -
- ~23B units in 2020
- Today: Etched antennas: polluting manufacturing process leading to non-eco-friendly tags (Plastic + Aluminum).
- Copprint: **Compostable and less Expensive** printed RFID antennas  
Paper + Copper



RFID	Etched Aluminum on Plastics (PET) (>90% of the market)	Copprint Printed Nano Copper on Paper
Manufacturing	Highly polluting (China and Malaysia)	Simple printing
Turnaround	6 weeks	1 week
Tag disposal	NON recyclable: Plastics, Aluminum High volume, small pieces	Compostable, Green RFID Paper, Minimal copper traces
UHF antenna cost	0.2-0.6c	Up to 30% cheaper (depending on geometry/volume)
NFC antenna cost	1c	<0.4c

## Example 2 – Printed heaters on PET

Application:

Seat heaters, interior panel heaters, battery heaters, defoggers

Today – most heaters are made using silver inks.

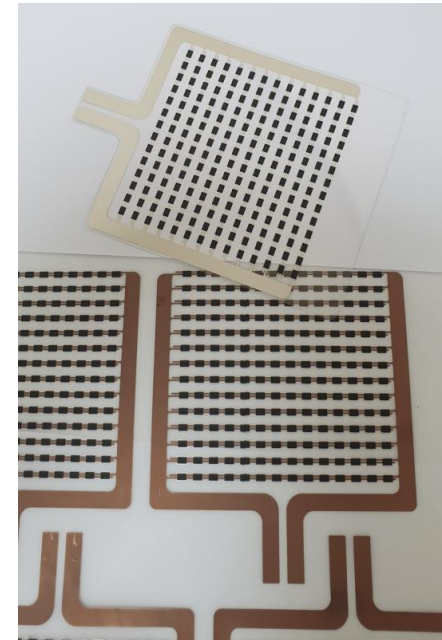
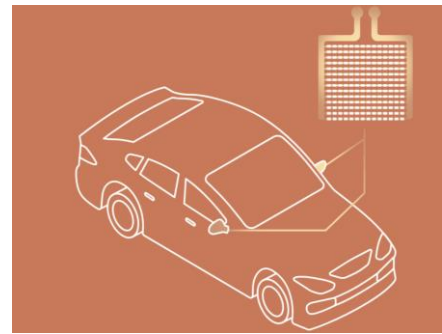
With copper:

Same design

Better electrical properties -> less material

Same performance

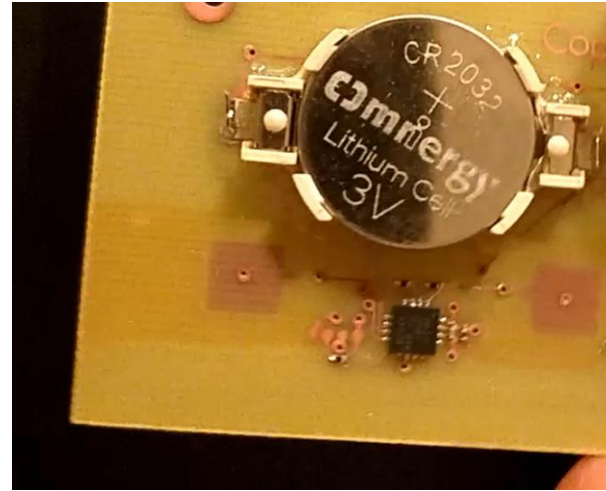
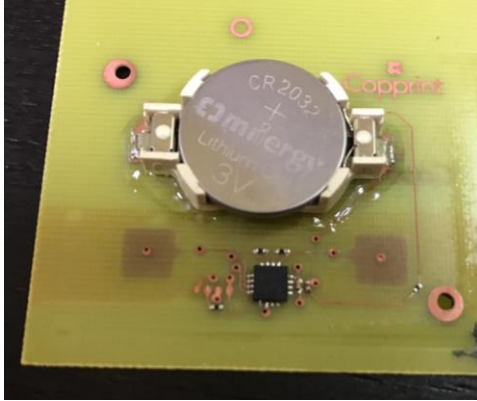
**5-10x less expensive**



# Example 3 – Simple production of 2-sided PCB Printing Copper on FR4

Instead of polluting etching process:

- Screen Print through the via-holes
- Screen Print side 1 ; Screen print side 2
- Short drying
- Sintering via hot-press



<https://youtu.be/mnsLalBA5iA>

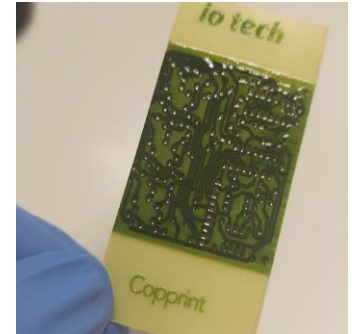
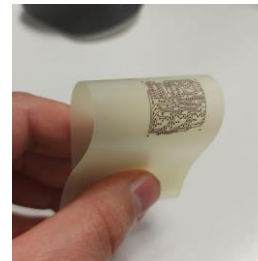
# Example 4 : 2-sided PCB using Laser Assisted Deposition

- Collaboration with ioTech [www.i-o-tech.com](http://www.i-o-tech.com)
- High throughput – 7x7cm 2-sided PCB on FR4 <15 min.
- Via hole printing
- Multi-material & multi-layer
- Solder paste deposition
- High resolution - 60 $\mu$  lines @25 $\mu$  height
- Digital direct-writing & post-processing



Beta testing 2021

Availability 2022



2-sided PCB on FR4 + solder mask  
3x9cm <3 min print time

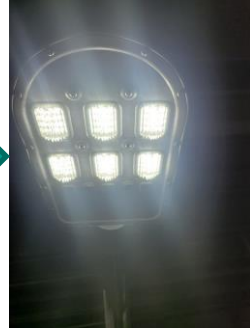
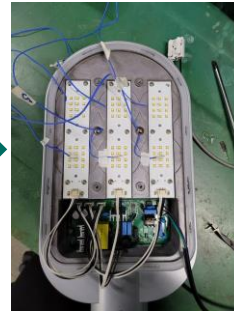
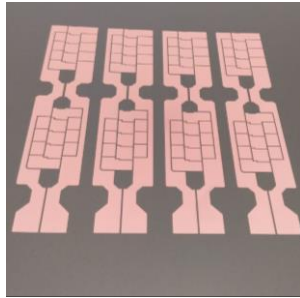
# Example 5 – Printing copper on Glass for LED transparent display boards

Instead of polluting etching process:



# Example 6 – Printed copper traces on anodized Aluminum for LED- baseboard

Instead of polluting etching process:



Pre-cut anodized aluminum

Copper printing

SR Printing

LED SMT

Assembly

Testing

**ips** [ipss.co.kr](http://ipss.co.kr)

 Copprint



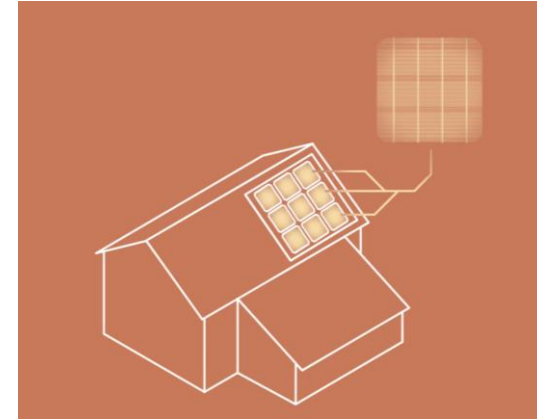
# Example 7 – Printed copper traces on PV wafers

Silver inks used in PVs are made comprise 20-30% of the PV module cost

Copprint already demonstrated high-efficiency working HJT and IBC PV cells with >10% \$/watt cost saving per module!

Passing DH2000 (85°/85%, 2000 hours) , TC400 (-40°:+85° x 400 cycles)

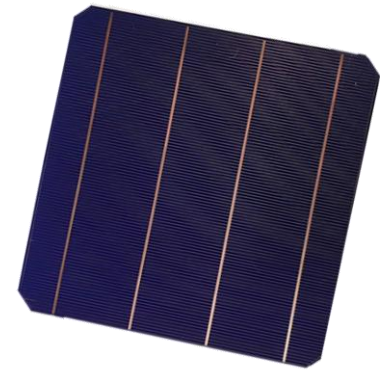
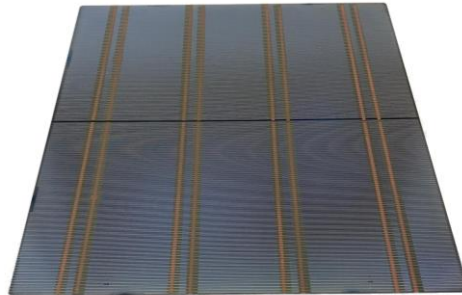
Dramatically reducing cost / Accelerating green energy sources.



IBC cells in collaboration with:



International Solar Energy  
Research Center Konstanz





# Why Copprint inks are so attractive?

## Focus on price/performance.

Example: comparing two pastes with similar solid-content

	Sheet resistance ( $m\Omega/\square/25\mu m$ ) ↓	Price per Kg ↓
Copper paste	3	€310
Silver paste	8	€900

Cost performance ratio is  $(900 \cdot 8) / (310 \cdot 3) = 7.7X$



Conductive paste parameters:

Cost ↓

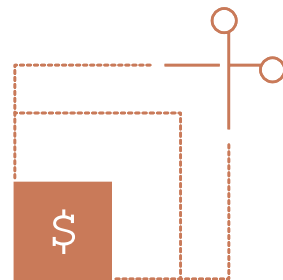
Conductivity ↑ (sheet resistance ↓)

Solid content ↑

Minimum layer thickness ↓

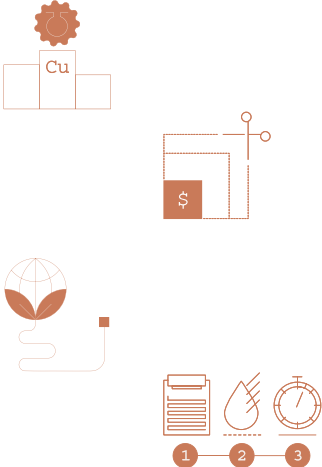
↓ - lower is better

↑ - higher is better



# Summary - Conductive copper paste

- Higher conductivity
- Less expensive
- Higher sustainability
- Simple fabrication



Make the switch before your competitors do !

For orders and further information: [www.copprint.com](http://www.copprint.com)



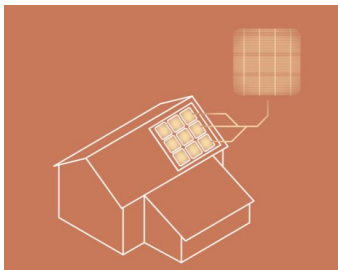
Founded: 2016  
All product are available in stock  
Annual Production capacity >12 Ton

Copprint Strategic Investors

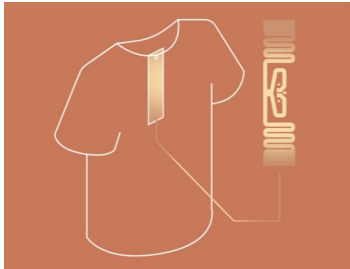


# In 10 years Copprint products will be:

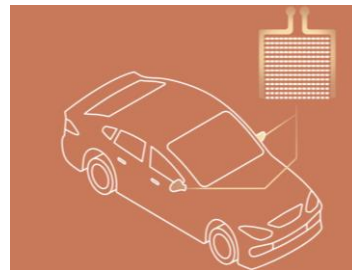
*On every roof...*



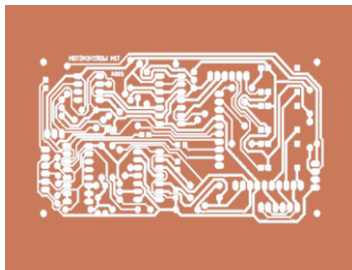
*On all merchandise...*



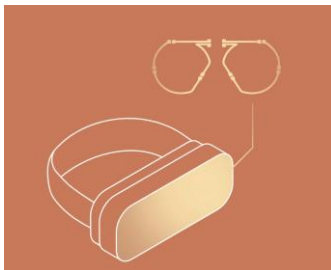
*In every car...*



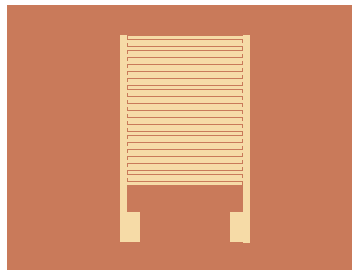
*In every circuit board...*



*In every gadget...*



*In every sensor...*





Thank you.