(C) 2017

NANODIMENSION
3D PRINTED ELECTRONICS

A New Dimension in the Production of Professional Multilayer Printed Circuit Boards and 3D Circuitry



Simon Fried
CBO and Co-Founder of Nano Dimension

www.nano-di.com

NASDAQ / TASE: NNDM

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3D PRINTED ELECTRONICS

Why 3D Print in General?

- Rapid Innovation - freedom to experiment
- New complex geometries
- Shift towards flexibility and customization
- Faster time-to-market
- Environmental sustainability

Image: Mark Zuckerberg/ FaceBook

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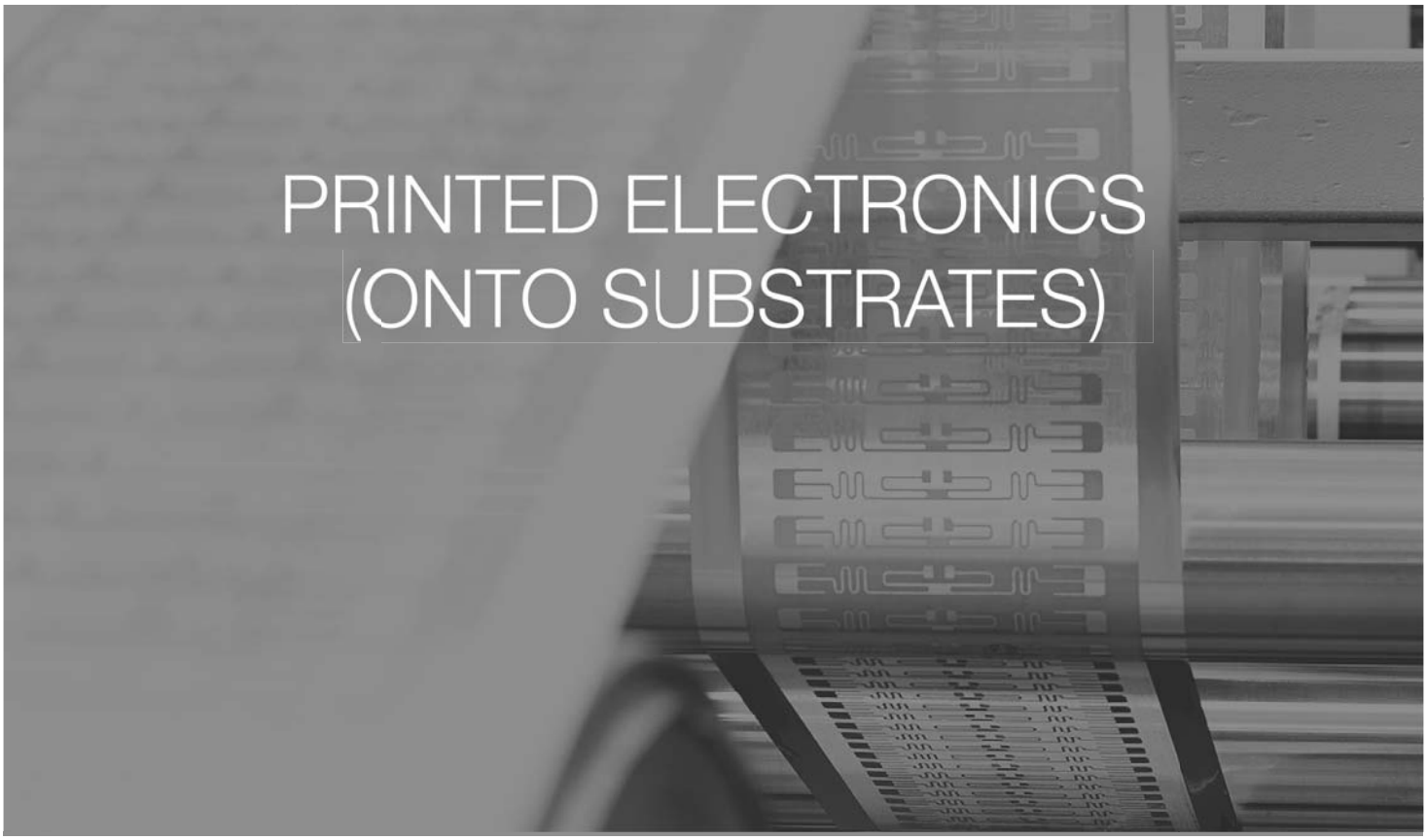
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PRINTED ELECTRONICS

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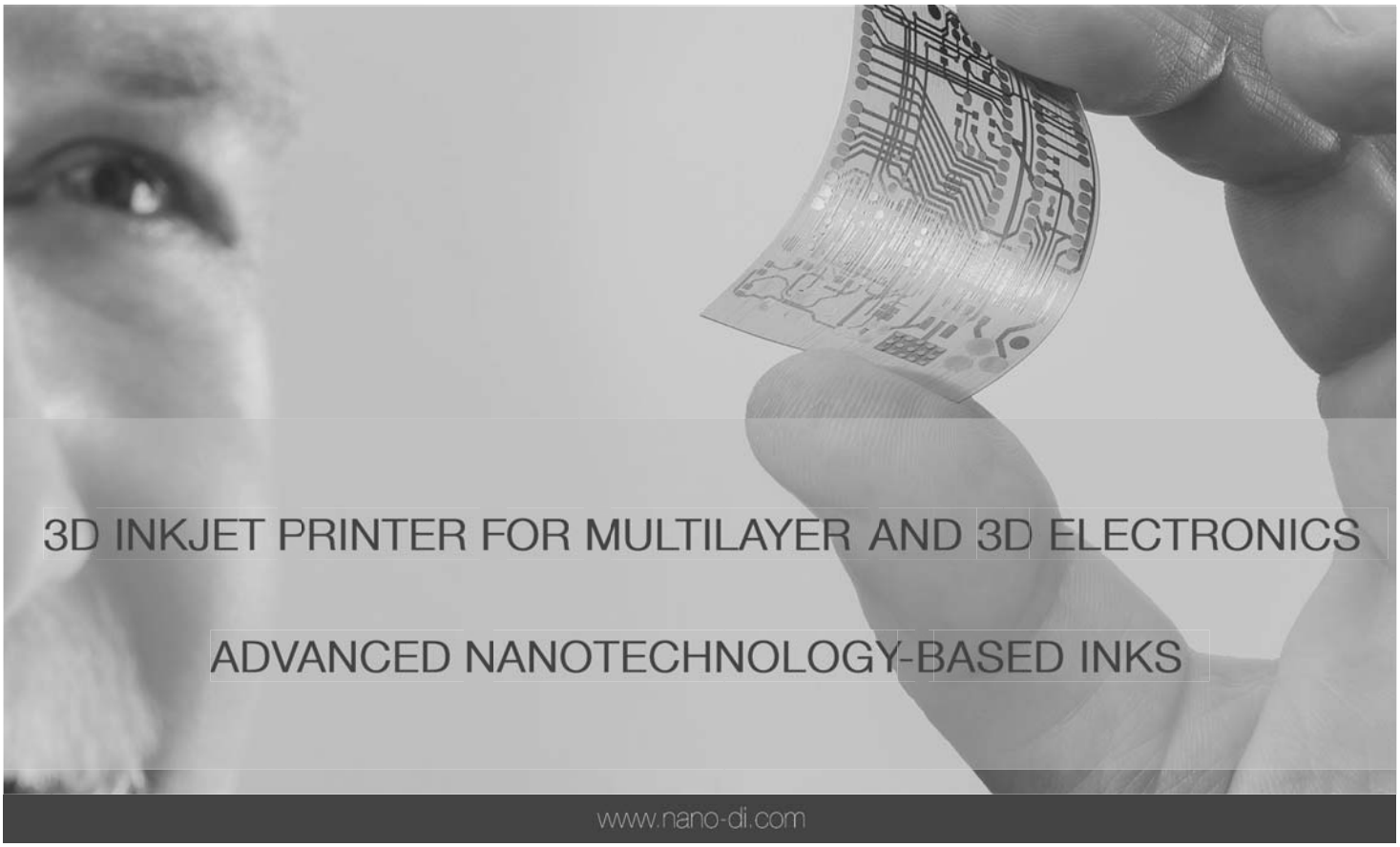
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3D PRINTED CIRCUITS (3D PCB)

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Desktop 3D Printer with Inkjet technology

- Advanced inkjet printheads with hundreds of small nozzles
- Tiny droplets of conductive and dielectric materials deposited

Sophisticated proprietary software

- Gerber file loaded into the printer's interface
- System automatically calculates the ink drop placement

Nano Chemistry

- Advanced silver nanoparticle conductive ink
- Dielectric nanoparticle ink

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- Founded - 2012, NASDAQ / TASE listed (NNDM)
- 80+ employees
- Beta testing with customers

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The PCB Prototyping Challenge

Design file sent to 3rd party manufacturer

- Several weeks
- Slow time-to-market

Nano Dimension's 3D PCB Solution

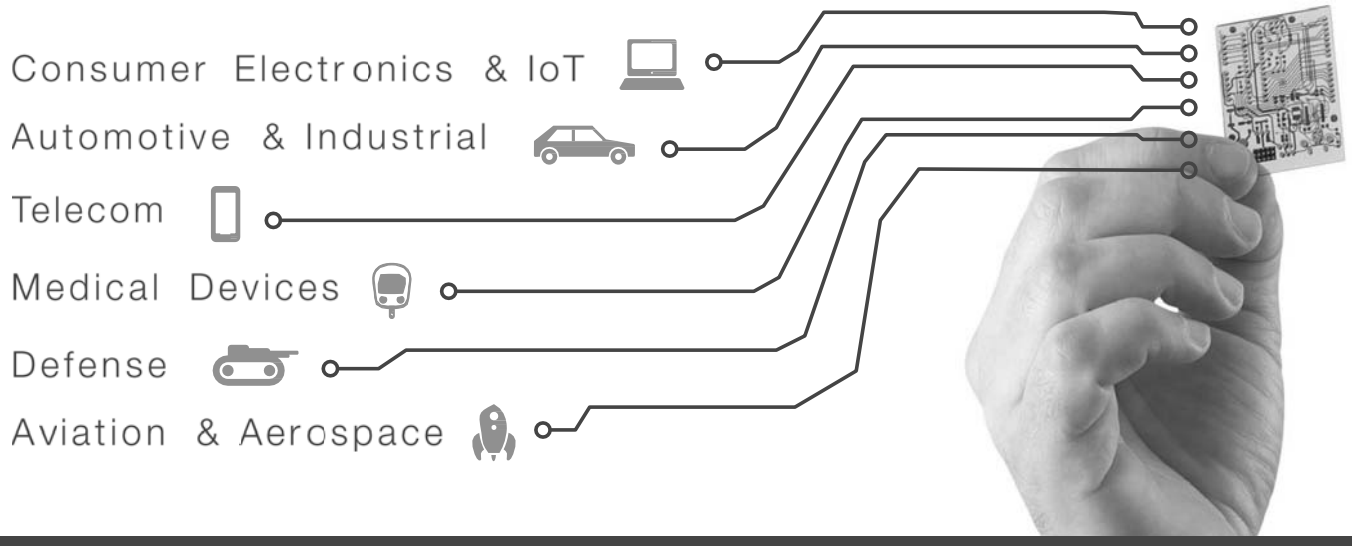
3D printer: In-house rapid prototyping

Hours!

- Faster time-to-market
- Freedom to innovate
- Protect IP

Electric Circuits (PCBs) Everywhere

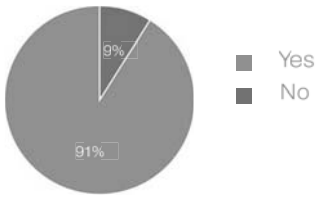
Growing Opportunities in a Diverse Set of Industries



PCB Prototyping Survey

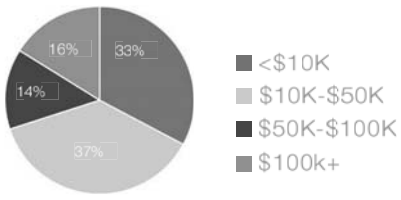
Do you use short-run, low-volume external PCB prototyping services?

N=978



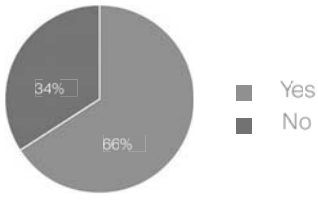
How much do you typically spend on PCB prototypes each year?

N=915



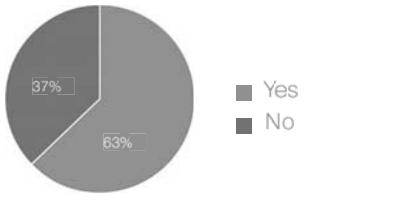
Do the PCBs you use have high layer counts?

N=978



Do you worry about IP security when sending designs to a 3rd party?

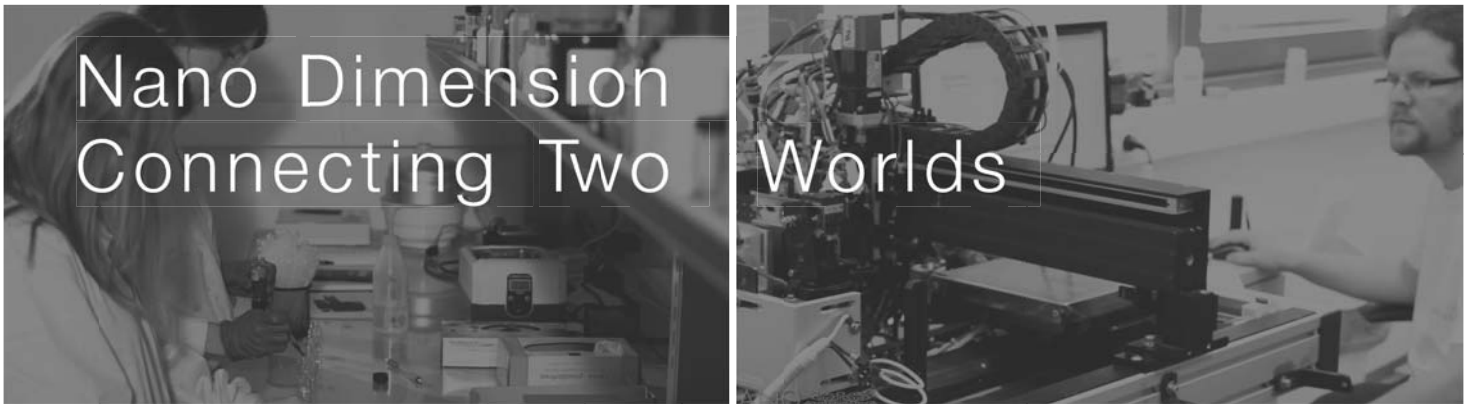
N=978



Source: * Nano Dimension Printer Readiness Survey 2016, as at 18 October 2016

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High Performance Nano Inks



Advanced 3D Printing

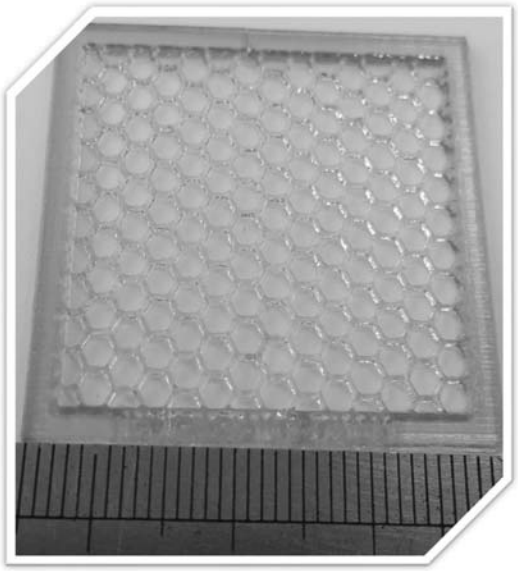
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POLYMER:

DIELECTRIC & STRUCTURAL



METAL:

HIGHLY CONDUCTIVE SILVER

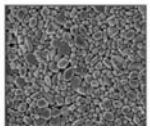


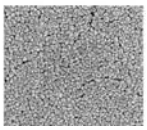
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AgCite™ Conductive Inks

Up to 75% of the conductivity of bulk copper

- Sizes and distribution of the silver particles optimized for 3D printing of highly conductive PCB traces
- Developed using a patent protected nanoparticle synthesis process licensed from Yissum & Prof. Magdassi of the Hebrew University





Silver Nanoparticles

10-100 nm size range produced by Nano Dimension in a range of shapes and distributions in accordance with ink requirements

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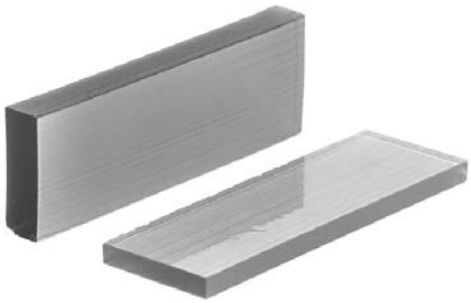
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4Dimension Dielectric Ink

- Designed for compatibility with Nano Dimension AgCite ink
- Mimics industry FR4 and other dielectrics (range of formulations)

1. **Dielectric**
2. **Structural:** 3D Printing
3. **Mechanical:** Rigid & Flexible

1. Dielectric (matched to AgCite conductive ink)



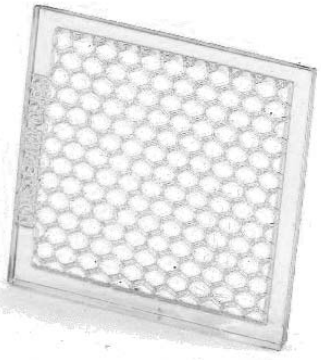
Dielectric Constant @1MHz: 2.2-3.7
Loss Tangent @1MHz : 0.02-0.03

Dielectric Constant @1GHz: 1.9-4.5
Loss Tangent @1GHz: 0.02-0.4

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2. Structural



High flexural strength: 200 Mpa

High temperature resistance: >360°C

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3. Rigid & Flexible



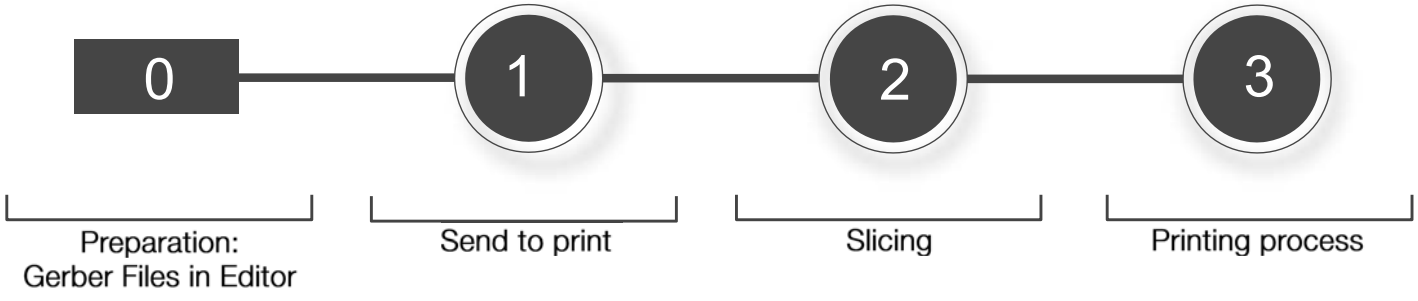
Define # of print layers to achieve flexibility or strength

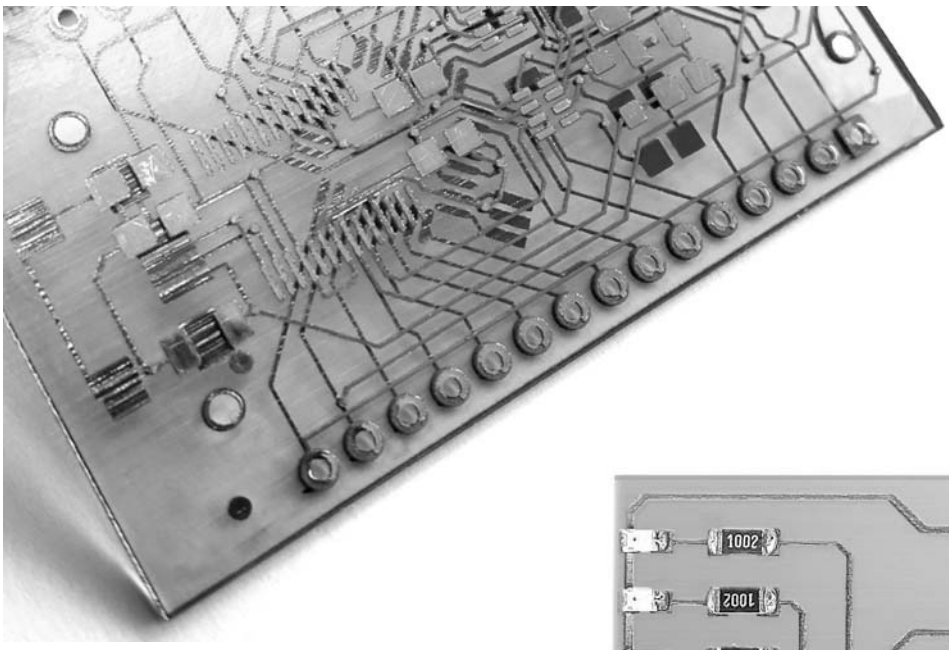
Benefits:

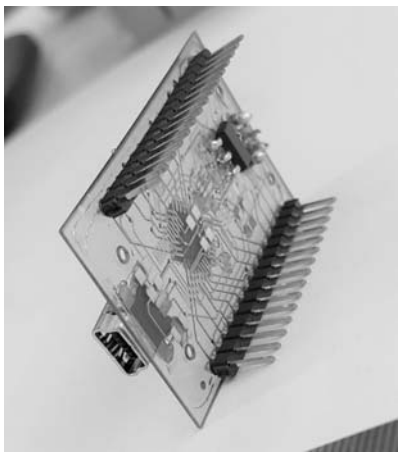
Customize flexibility for your design

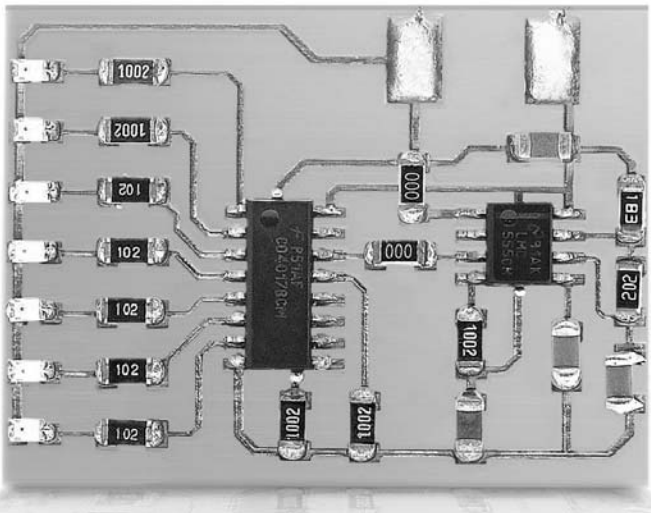
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PCB Easy as 123

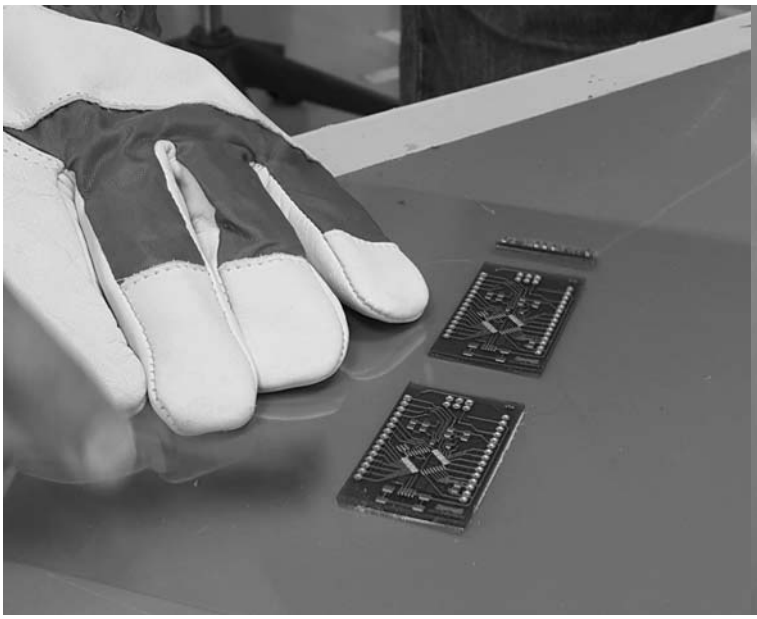


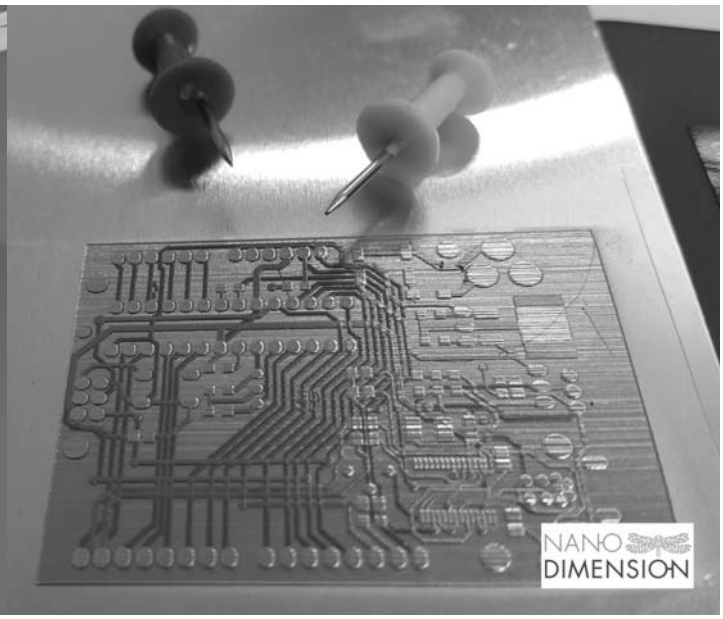






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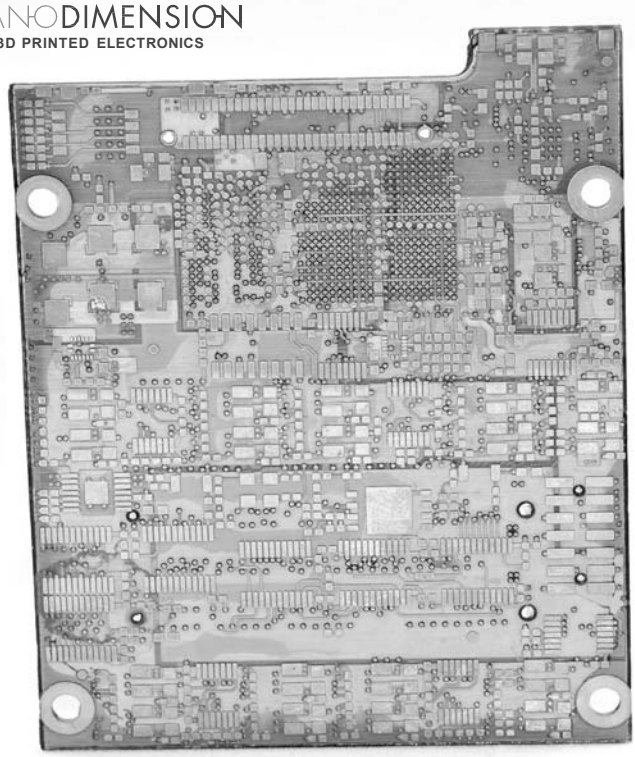
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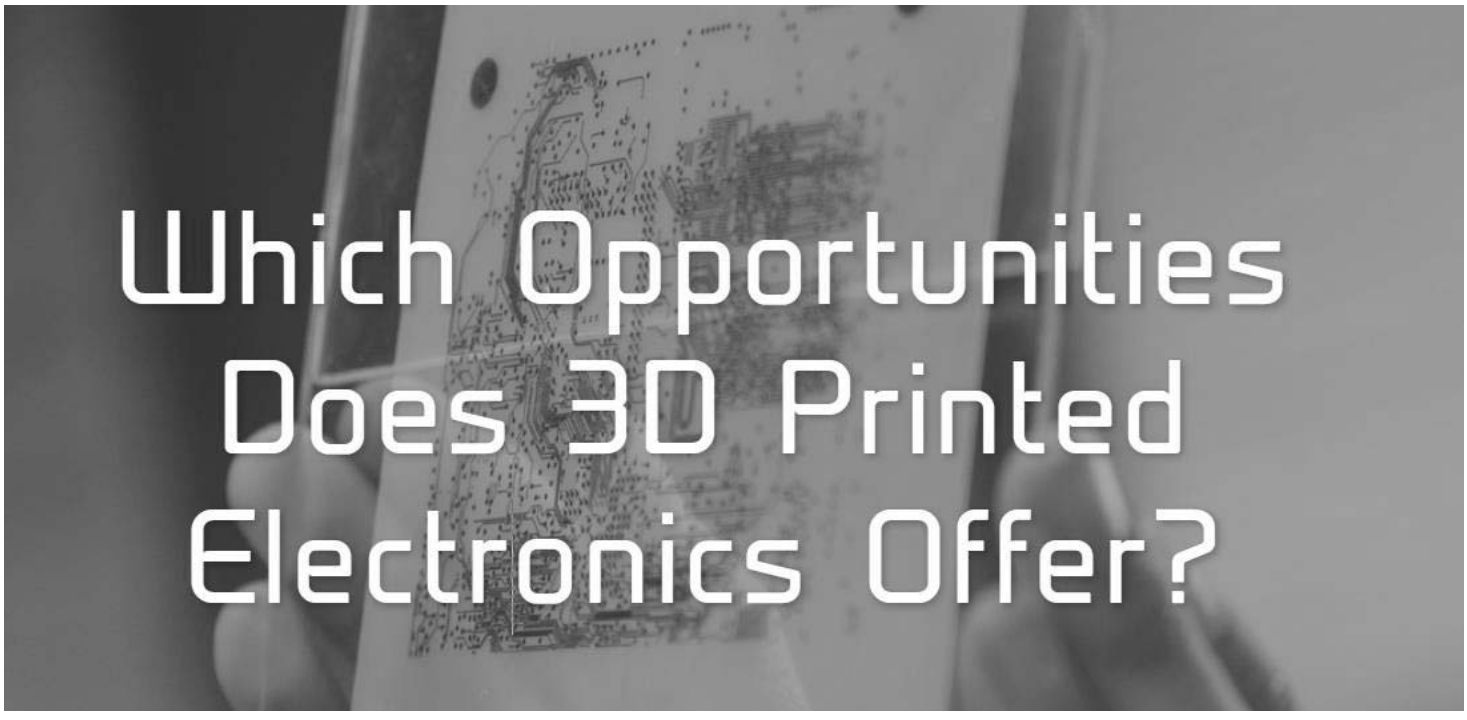
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10 Layer PCB: Fully 3D Printed

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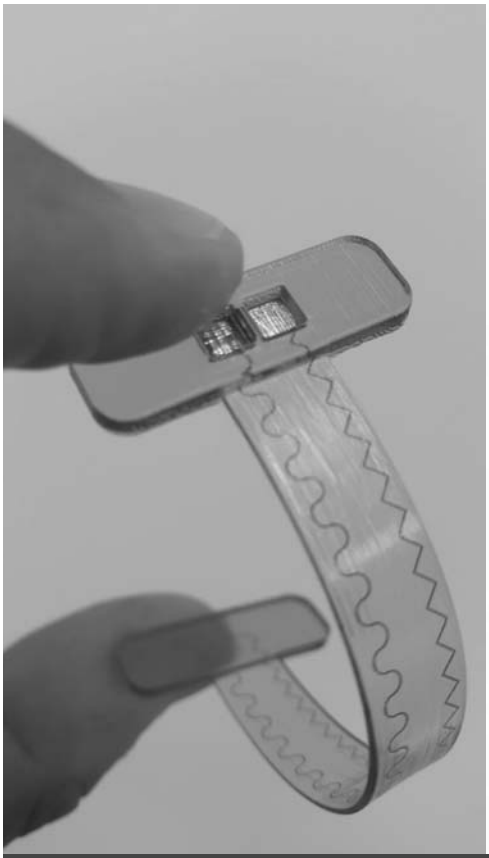
3D Printed MID: Conformal & Multi-layer Circuitry

3D File Credit: FAPS Nuremberg

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Rigi-Flex 3D Printed in One-Shot

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Structural & Functional





18 Patents / Patent Applications:

- 3 patent families - Conductive inks, Prof. Magdassi, Hebrew University
- 14 patents - System, printing process, software, materials, design
- 1 patent - 3D printing of stem cells

Additional IP:

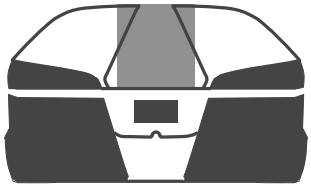
- Nickel nanoparticles, collaboration with Prof. Markovich, Tel Aviv University
- Developing nano copper ink

Future Roadmap

Progress Towards More Advanced Solutions and Additional Markets

Prototyping

3D PCB Printer for fast prototyping



Speed	Unique technologies for jetting, curing etc.	Industrial production thr oughput potential
Scale	Larger objects Higher resolution traces	Meeting the needs of additional market segments
Materials	Broaden materials portfolio, functional inks	Applications to print electrical components: resistors, capacitors, transistors

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THANK YOU



simon@nano-di.com

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