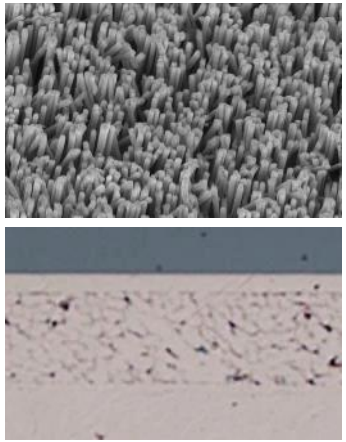
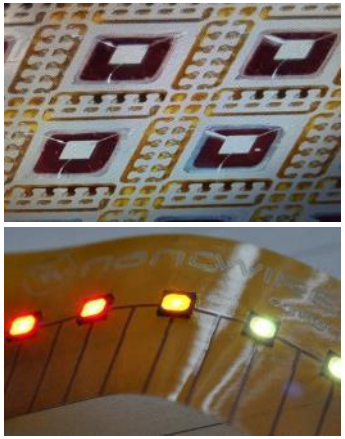
NanoWiring, KlettWelding, KlettSintering, KlettGlueing

As simple as „LEGO“





nanoWiring nanoInspection KlettWelding KlettSintering KlettGlueing

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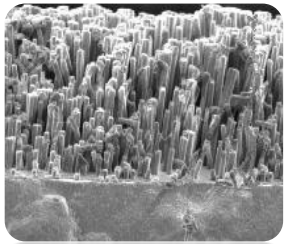
Disruptive solution in interconnection

nanoWiring



KleWelding
KleSintering
KleGlueing

Horizon 2020

LOEWE
Exzellente Forschung für Hessens Zukunft

- **>30** patents
- 2017 founded
- **>50** signed customer contracts

Volkswagen · Continental The Future in Motion · ON · HONDA · JUMO · WIKA · SIEMENS · infineon · OSRAM · nexperia · NXP · BOSCH

LED, flex PCB, MEMs etc.

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applied to electronic packaging

nanoWIRED connects...

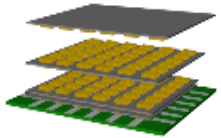
1.Masking

nanoWiring

2.Wiring

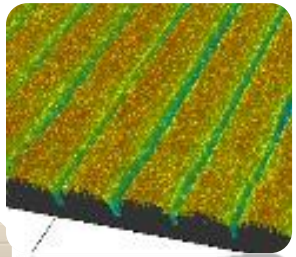
nanoVision

3.Stripping



KleiWelding

4.Stacking



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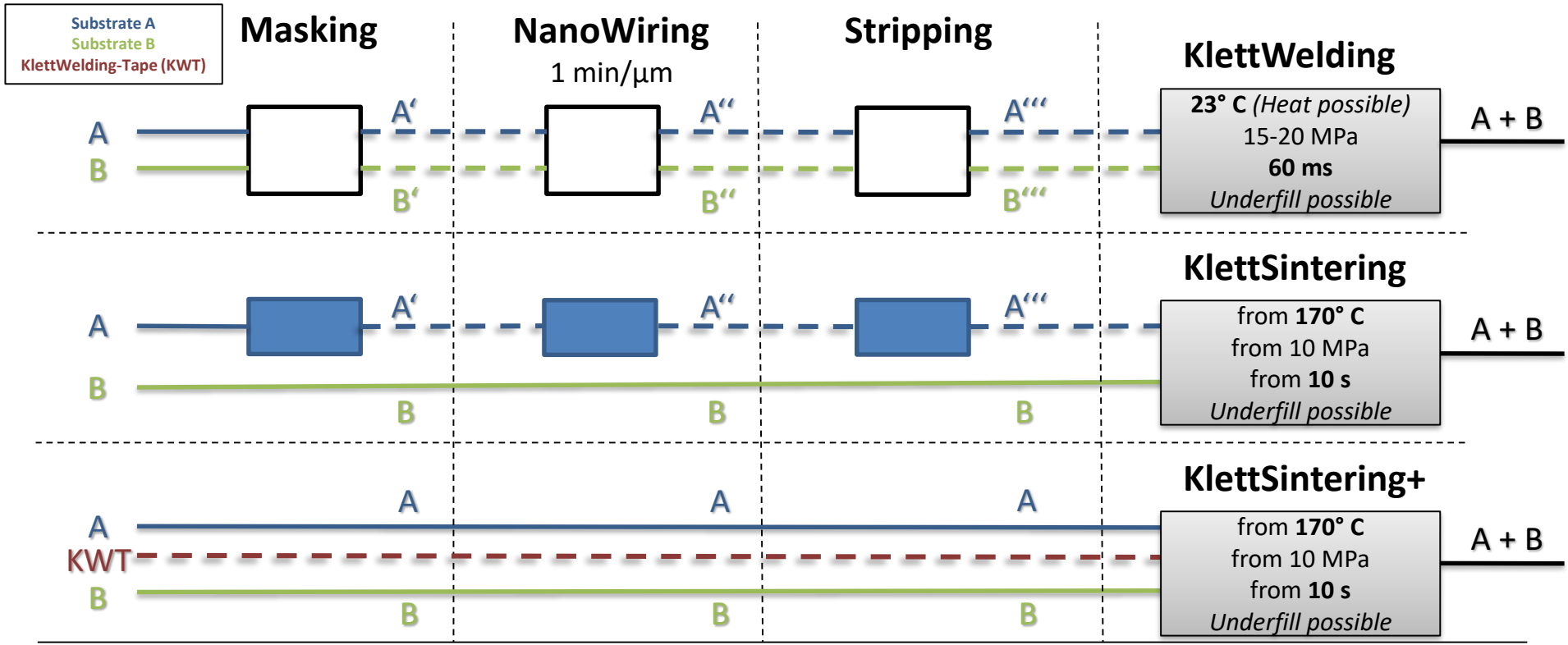
Variation of joining methods



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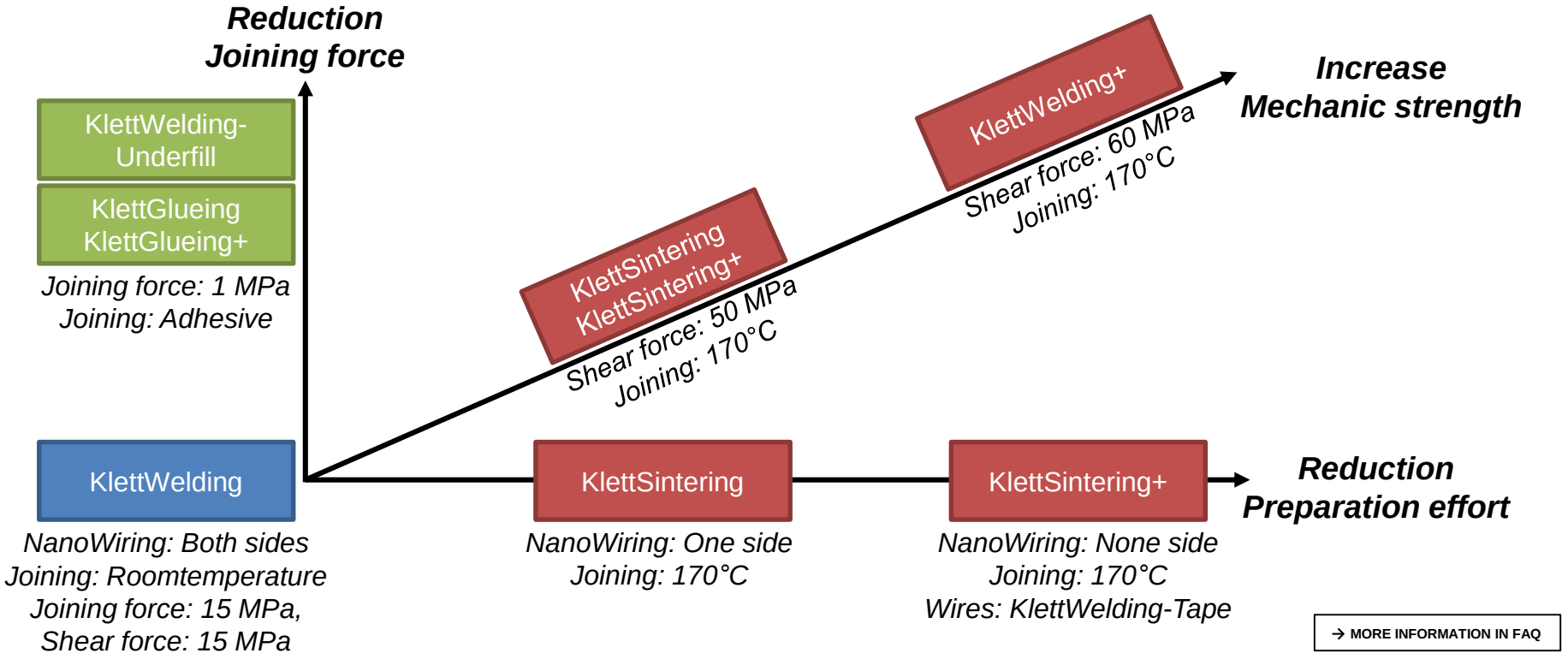
Overview of joining methods



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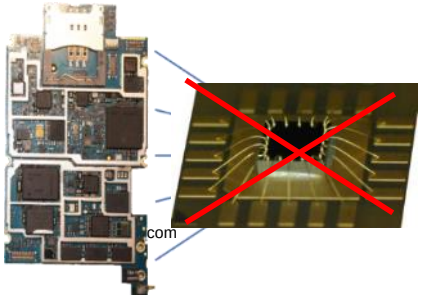
Unbeatable Value Proposition

Smart Cars

Consumer electronics

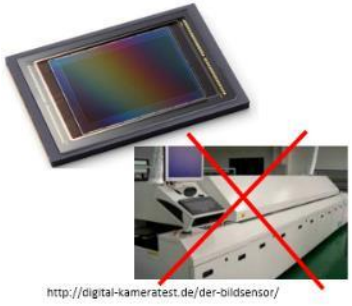
LEDs

Space 3D



No Bond Wires

Lifetime



No Reflow Heating

Precision

No Movement

Heat-resistant

No Melting

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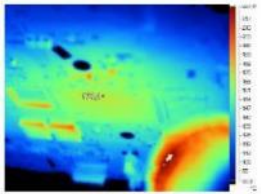
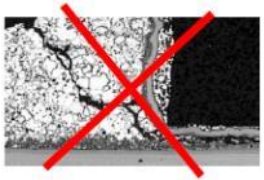
Unbeatable Value Proposition


Sensors



Others

Grade pure metal

No brittleness

Cu / Au / Ni / Zn

~~KCN - NaCN - Se – Hg~~

No environmental damage

~~F - Cl – Br – I – At - Ts~~

No halogens

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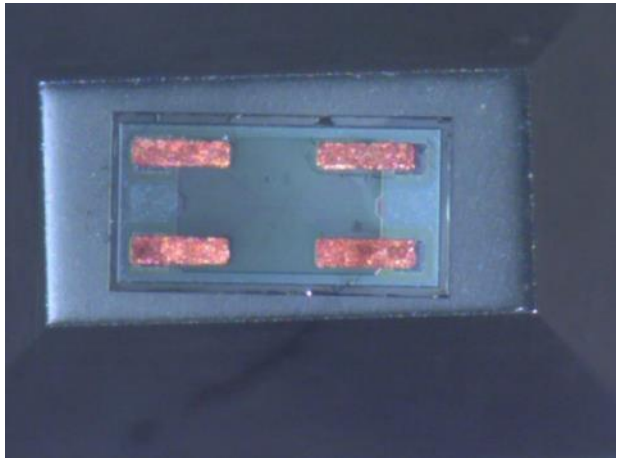
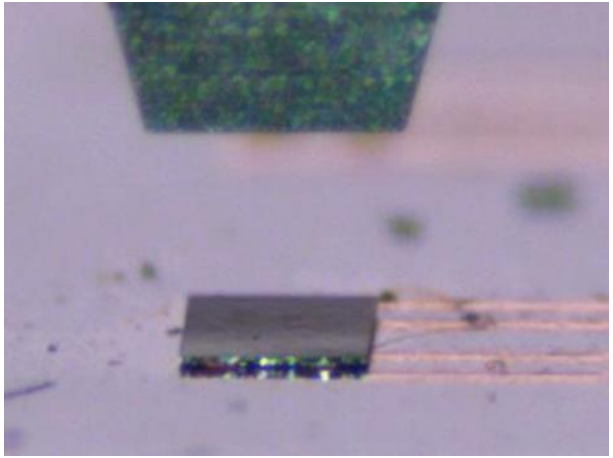
Force-, Temperature-, Optic- Sensorics

- Contacting very sensitive elements - 20µm chip thickness
- Handling of single chips





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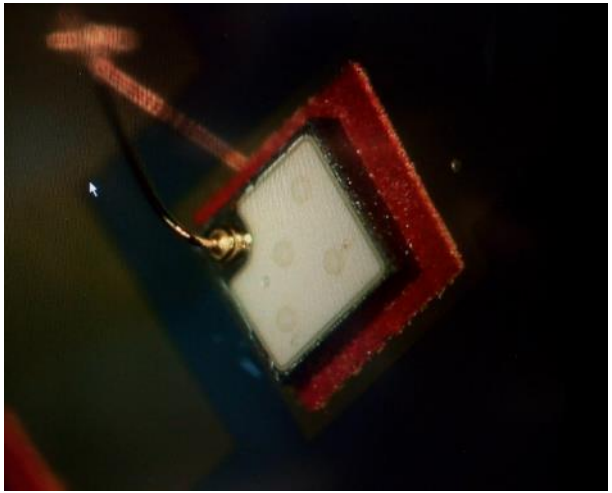
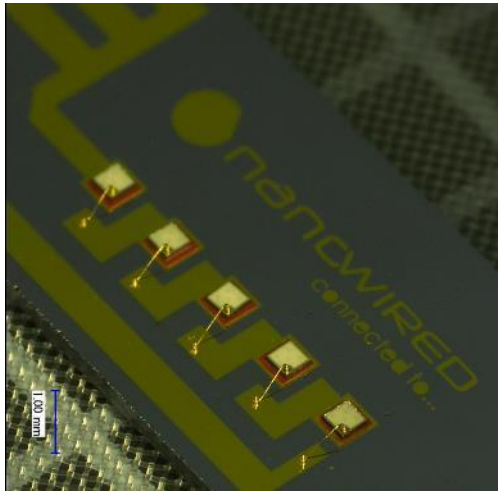
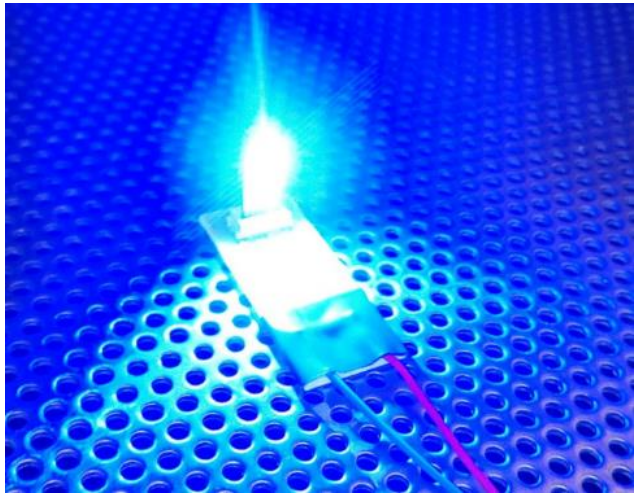
LED – best current transmission

- Higher precision in the optical axis
- Higher currents at the same temperature







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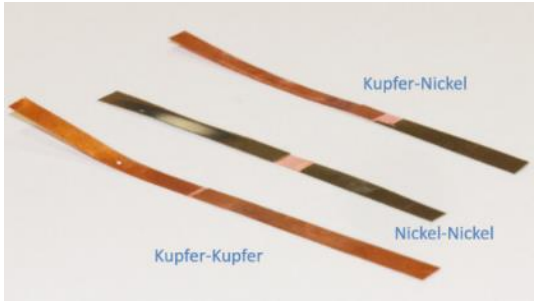
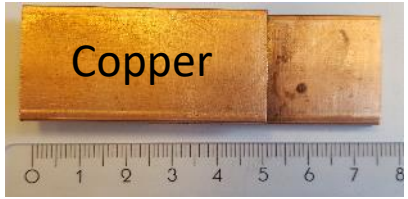
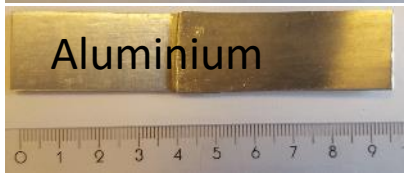
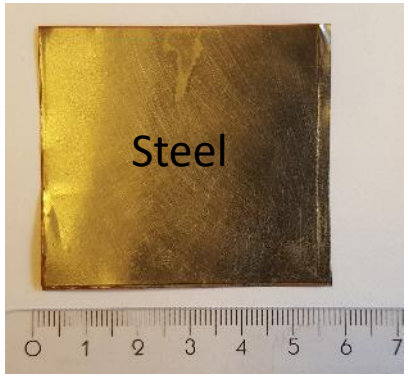
KlettWelding for high current

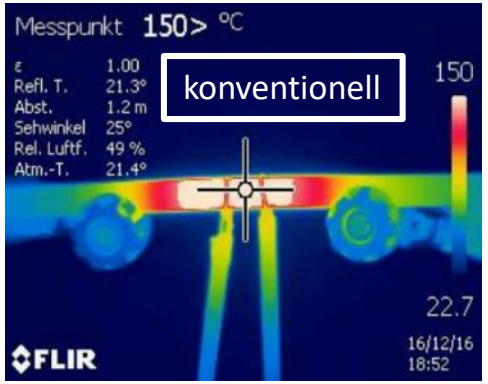
- Metal flags, NanoWiring - Cu
  - Full-surface, rectangular
  - 6,6mm edge length
  - 670N / 15 - 20MPa
  - Only 30% of the original warming

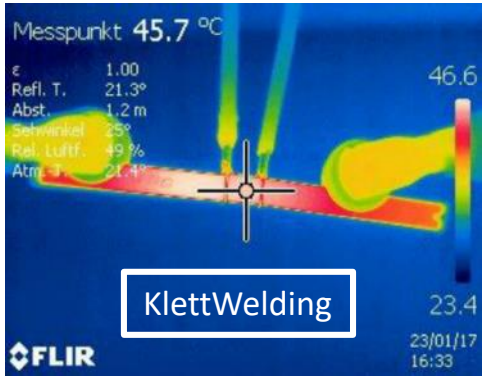












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KlettWelding-TAPE

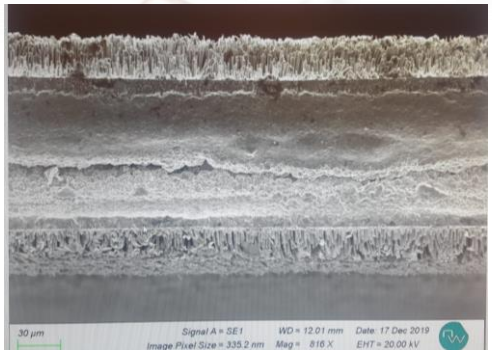
- Substitution of welding, brazing, silver sintering,….

Copper

Gold

Silver

Nickel



Isolation-7,8 kV via Polyimid foil

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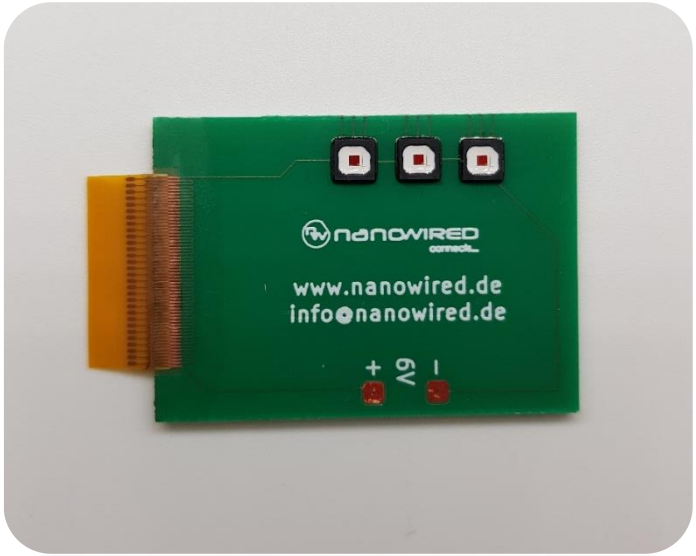
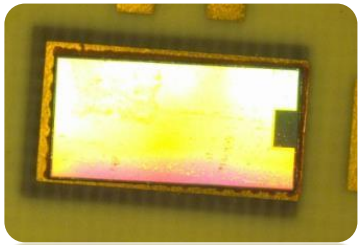
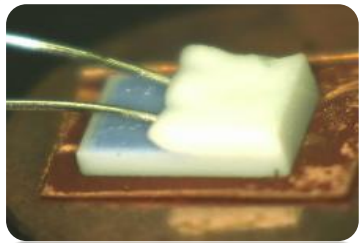
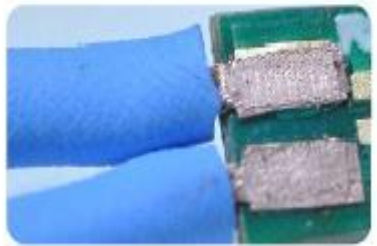
Ideal for mobile or tablet applications

Peel forces above 1.5 N/mm









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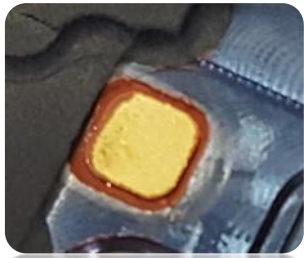
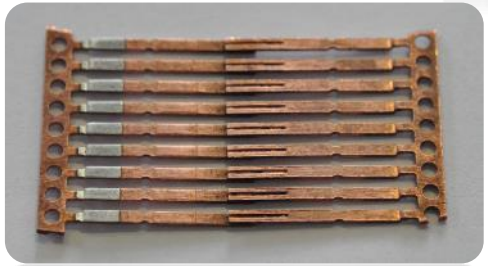
Contacting and sealing enclosures





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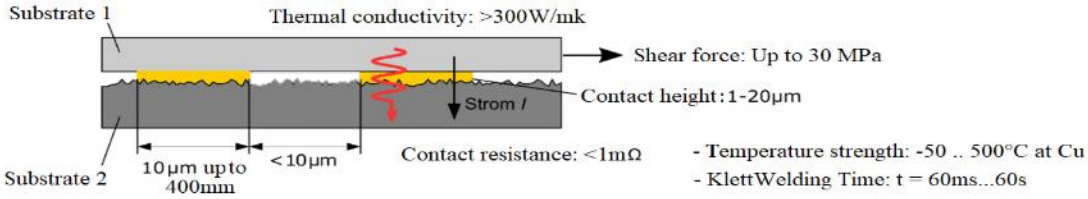
KlettWelding / KlettSintering properties



Bond Force	**3-150 MPa**
Bondline Thickness	**Ca. 1/6 * Sum NanoWiring Length**
Shear Force	**Up to 60 Mpa**
Pull Force	**Up to 40 MPa**
Peel Force	**Up to 1,7 N/mm**
KlettWelding Temperature / KlettSintering Temperature	**Room Temperature up to max. 450° C / from 150° C up to 450° C**
KlettWelding Time / KlettSintering Time	**60ms – 60s / 10s – 480s**
Temperature strength	**-50°C-500°C (Cu)**
Contact resistance	**< 1 µΩ/mm²**
Thermal conductivity	**350 W/mK**
Coplanarity	**ca. ½ x NanoWiring Length**
NanoWiring Material	**Copper, Gold, Nickel, Zinc, Silver, Platinum, Indium, Tin,…**
NanoWiring Diameter	**30 nm to 4 µm**
NanoWiring Length	**500 nm to 50 µm**
Substrate Material	**Ceramic (LTCC …), Polymer (PI, PCB), Glass, Silicon, Aluminum, Steel …**

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Your access with 4 stages

Design-In	Production	Equipment	KlettWelding-Tape
• Application development • Process development • Know-how transfer	• Production in Gernsheim • NanoWiring • KlettWelding / KlettSintering	• Machines and equipment • Consumable • Service	• Structure-Variation • Metal-Variation • Thickness-Variation
 **Phase 1**	 **Phase 2**	 **Phase 3**	
Each customer starts here Quick-Test: 2.000€ Training: 2.000€ Starter-Kit: 5.600€ Basic-Package 10.000€ Welcome-Package: 20.000€ Projekt: 100.000€	**e.g. sensor industry & Subassemblies Producers** *Small series and medium series producers such as sensors, automotive, busbars, submodules. Companies without cleanroom production.*	**e.g. semiconductor & high-volume market** *Large series producers such as Mobile, LED, Commodity, Automotive, Semiconductors. Companies with cleanroom production and infrastructure.*	**e.g. Industry & high-volume market** *Bus-bar and 3D-Electronics* *Substitution of silver-sintering substitution of welding* *Pressure-tight and waterproof* *Extension of bonline-thickness*

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Possibilities for project entry

Project Entry	Starter Kit KlettWelding-Tape	Basic Package	Welcome Package	Training	Quick Test KlettWelding-Tape	Quick Test NanoWiring	Pilot Project
Budget	5.600 €	10.000 €	19.600 €	2.000 €	2.000 €	6.000 €	100.000 €
Delivery Time	2 Week	1 Month	2 Months	-	1 Week	1 Week	> 6 Months
Scope	2 sheets A4 KlettWelding-Tape (1x long & 1x short NanoWires) + KlettWelding Activator	Optimization + documentation + discussion	Optimization + Prototypes + documentation + discussion	-	~ 5 prototypes	~ 5 prototypes	Larger amount of test-samples + Parameter variation + documentation + discussion
Aim	Quick entrance into technology by applying in basic test condition. Self-testing	„Basic package“ with parameter optimization and quality inspections	„All-included service package“ with parameter optimization and quality inspections → prototypes for own tests	Coaching of technologically know-how → practical training	First quick results → basic feasibility of KlettSintering by using KlettWelding-Tape	First quick results → basic feasibility of KlettWelding / KlettSintering / KlettGlueing with NanoWiring on the substrates	Product development project after entrance into technology

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NanoWired GmbH, Gernsheim

Clean Room ISO10 – ISO5

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To satisfy your hunger

NanoWired Cookie-Box

NanoWired Contact

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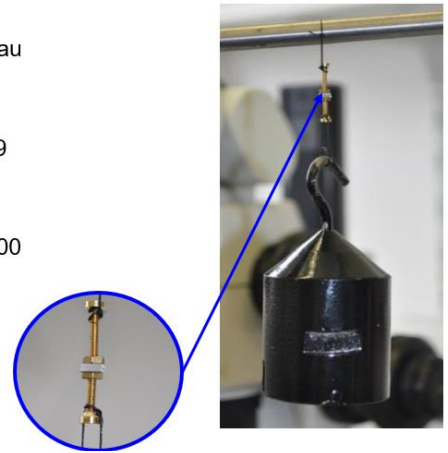

Science Life Gewinner Konzeptphase NanoWired Venture Cup 2016

STEP AWARD Preisträger 2018

HERMES AWARD 2019

GERMAN INNOVATION AWARD '20 WINNER

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Published NanoWired Patent Applications

Basics	
NanoWiring	DE 10 2017 104 905 A1
KlettWelding	DE 10 2017 126 724 A1
Connecting elements with nanowires	DE 10 2017 104 906 A1
Connecting electric conductors with nanowires	DE 10 2017 104 922 A1
Connecting thermal conductors with nanowires	DE 10 2017 104 921 A1
Connecting elements with nanowires and pillars	DE 10 2018 122 007 A1

Uses	
Semiconductor chips	DE 10 2017 104 923 A1
Stacks of semiconductor chips	DE 10 2017 104 902 A1
Sensor for flowing medium	DE 10 2017 104 904 A1
Force sensor	DE 10 2017 104 926 A1
Electric motor	DE 10 2017 104 925 A1

Further patent family members
are not included in this list.

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