Technische Hochschule Nürnberg

Near-Infrared LED Reflow Soldering for Flexible Hybrid Electronics [Photo-AVT]

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1. Motivation and Concept

Assembly of highly miniaturized components with concealed connection structures (QFN, CSP) requires continuous or mass soldering processes. Established soldering processes are only suitable for the manufacturing of flexible hybrid electronics to a limited extent:

- Damage to low-cost film substrates
- Low printed layer thicknesses require short process times
- High energy consumption is required for assemblies with low component density

Design and development of a reflow soldering technology with selective photonic heating for low-cost substrates by utilizing material-dependent absorption in the NIR wavelength range to achieve:

- Reduction of substrate deformation
- Selective heating of populated areas
- Irradiation through the substrate to reduce shadowing of connections
- Shortening of process time
- Reduction of energy consumption

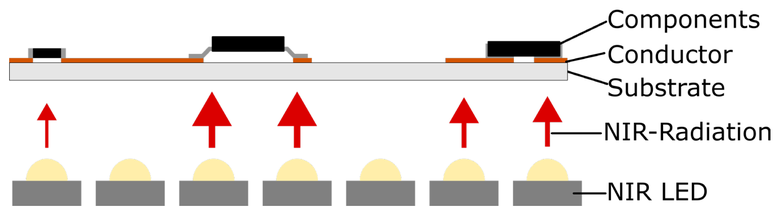

Fig. 1: Locally controllable irradiation of components

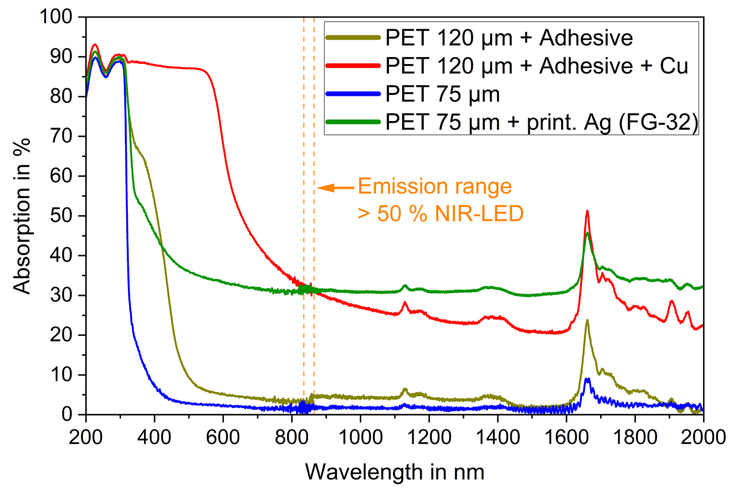

Fig. 2: Absorption of substrate and conductor materials

2. Implementation

Development of a soldering process with individually controllable NIR LEDs for layout-dependent soldering of a wide range of components:

- 48 (2 rows of 24) NIR LEDs ①
- Preheating of the assembly using an integrated heating plate ②
- Soldering unit on a speed-controlled axis ③
- NIR-transparent workpiece carrier made of a metal frame and PET mesh ④
- Reflector for better energy efficiency and shorter process times ⑤

- Layout-dependent irradiation ➔ local heating of areas with solder joints
- Component-dependent irradiation ➔ reducing the influence of component size and thermal mass on the peak temperature

Fig. 3: Prototype of the developed soldering process

3. Results

- High process repeatability
- Short times above liquidus
- Suitable for conventional etched Cu and printed Ag conductor

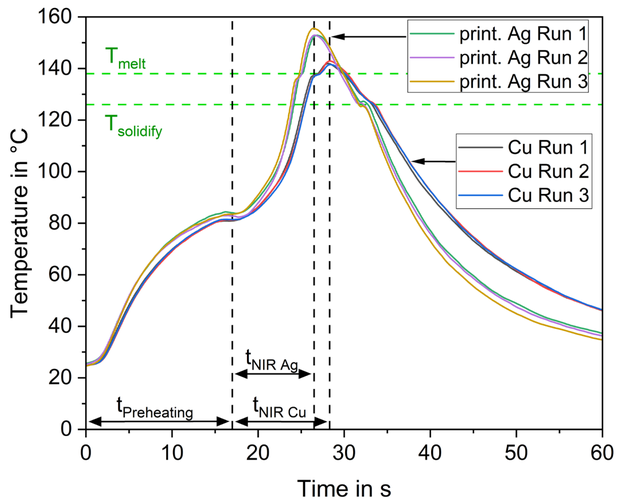

Fig. 4: Temperature curves for a 0603 chip resistor on etched Cu and printed Ag

- Good wetting despite short process time
- No increased pore formation
- No increased failure rate of the solder joints after accelerated aging

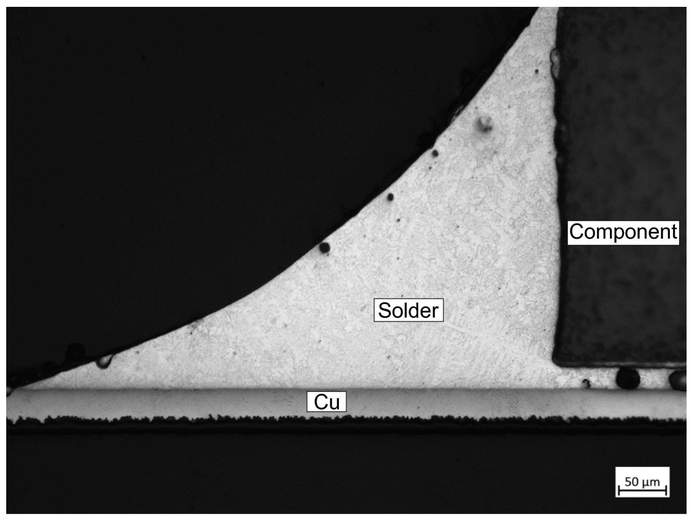

Fig. 5: Microsection of a solder joint on Cu

- Processing of a wide range of passive and active components
- Minimal deformation of the substrate materials

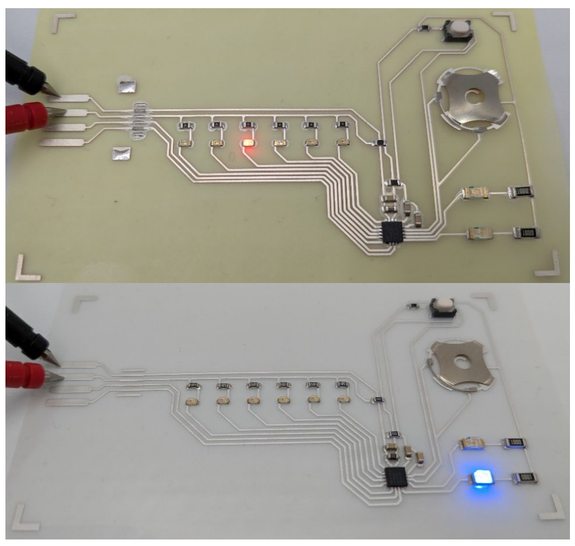

Fig. 6: Demonstrator on PET made of Cu (top) and printed Ag (bottom) conductors

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Bundesministerium für Wirtschaft und Klimaschutz

ZIM Zentrales Innovationsprogramm Mittelstand

Network and industry partners:

HIDRONIK Hybride Systeme mit gedruckter Elektronik

KUNDISCH

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