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MICRO ASSEMBLY TECHNOLOGIES

MICRO ASSEMBLY TECHNOLOGY | INKJET PRINTED ELECTRONICS | ADVANCED PACKAGING

INKJET PRINTED WIREBONDS FOR SENSOR INTERCONNECTIONS

PRINTED INTERCONNECTION FOR FLEXIBLE HYBRID ELECTRONICS

Advanced semiconductor devices and sensors often impose strict interconnection requirements due to fine pitch, fragile device structures, face-up sensor configurations, limitations in temperature, or pressure. Conventional wire bonding or flip-chip processes are not always suitable under these conditions. DoMicro has developed an inkjet-printed wire bonding process for the interconnection of bare dies and sensors. This contactless, additive process enables reliable electrical connections for advanced packaging and flexible hybrid electronics.

Figure 1. Inkjet printed wire bonds for the interconnection of microprocessor bare die

Figure 1 shows a sample with wire bonding interconnections performed with inkjet printing – showcasing several advantages:

- **Ultra-low profile integration:** Thinned bare dies can be integrated directly onto flexible substrates, reducing overall system height compared to conventional wire bonding.
- **Face-up compatibility:** Ideal for optical and sensor ICs where contact pads must remain accessible.
- **Low-stress processing:** No mechanical force, pressure, or ultrasonic energy is applied, making the process suitable for fragile devices.
- **Design flexibility:** Enables novel packaging concepts without wire loops – avoiding possible antenna behaviour, glob tops, or redistribution layers.

The process was validated in a wireless IoT demonstrator – Figure 2 – using a face-up, thinned bare die. To overcome inkjet limitations on vertical surfaces, a printed ramp structure supports the conductive traces.

This approach replaces conventional wire loops and enables a "die-first" assembly strategy with minimal height. Highlighting flexible substrate thickness of 50 µm, bare die thickness of 40 µm, and a total system height below 0.5 mm, with integrated Bluetooth and touch sensors. This ultra-thin form factor enables seamless integration into surfaces, labels, and textiles.

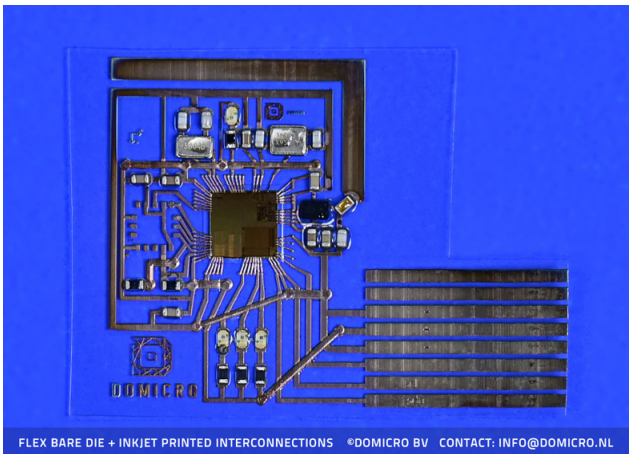

Figure 2. Wireless IoT demonstrator

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ADVANCED SENSOR INTERCONNECTIONS

Building on this work, DoMicro developed an interconnection solution for high-resolution opto-semiconductor line sensors. These applications require the interconnection of more than 250 pixels at a fine pitch of 100 µm, while accommodating fragile sensor structures and read-out electronics integrated on a flexible Chip-on-Film (COF) substrate.

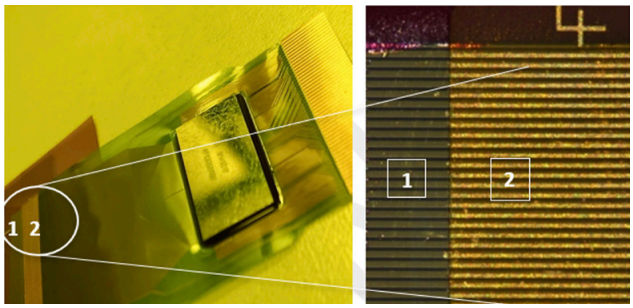

Figure 3. Sensor (1) and the COF (2) on top. Right image shows the alignment of the sensor pixels with the COF contacts at 100µm pitch.

Process Flow:

1. Bonding the COF to the sensor using non-conductive adhesive
2. Inkjet printing a ramp structure for Z-direction transition
3. Inkjet printing silver interconnection traces
4. Laser sintering of silver nanoparticle ink
5. Final packaging and encapsulation

Printing was carried out using the SÜSS MicroTec Pixdro LP50 inkjet platform, which offers UV pinning, substrate heating, compatibility with multiple industrial printheads, and high placement accuracy within 10 µm. The printed interconnections have a typical trace length of approximately 2 mm, a width of about 50 µm, a pitch of 100 µm, and an electrical resistance of around 2 Ω/mm. After printing and sintering, the assembly is protected by potting and encapsulation, ensuring mechanical protection, strain relief for the COF, and long-term reliability.

CONCLUSIONS AND OUTLOOK

Inkjet-printed wire bonding enables fine-pitch, low-stress interconnections for advanced sensors and flexible electronics. The process supports fragile devices, face-up configurations, and ultra-thin form factors where conventional interconnection methods are not viable. Next steps will focus on process repeatability, reliability testing and scalable process integration.

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DoMicro BV is a technology company providing innovative manufacturing technology, application solutions and micro assembly technology for flexible hybrid electronics (FHE) and micro devices. DoMicro develops cutting edge inkjet printing processes and technology for micro assembly and 3D packaging. At the forefront of innovation DoMicro offers state-of-the-art R&D services and exploration of new capabilities and applications for customers with manufacturability in mind. The company delivers R&D services, small series production, system architecture and project management. Typically for customers exploring new technologies for circuitry on flexible substrates like transparent conductive films, OPV electrodes, OLED, Lab-on-chip, wearables, in-mould electronics, IC and MEMS integrations.

If you are challenged by the market and looking for a partner to move your ideas into realization, contact us. We really do **IMAGINE, CREATE AND ACCOMPLISH.**

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