

Press Release

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High Speed Laser Soldering for Flexible Interconnection of Self-Bonding Copper Wires

For manufacturing processes with small and medium quantities in the sectors of electrical, medical and sensor engineering, the Fraunhofer Institute for Laser Technology ILT has established an automated laser soldering process that significantly increases the flexibility as well as the process speed of production. In view of the progressing miniaturization of building groups, this process has great potential.

Manufacturing highly integrated, electro-engineering components in Europe primarily demands, in addition to high quality, a high amount of flexibility to remain competitive against the cost advantages found in low-wage countries. Manufacturing facilities have to be transferable to a wide variety of products, preferably without retooling. In addition, quick, highly automated manufacturing procedures are necessary for largely unmanned manufacturing. Exposed to these requirements are small and medium-sized enterprises who occupy market segments for highly integrated electrical engineering components in small and medium quantities; such segments cannot be served by mass production facilities. Examples are innovative products from medical or sensor technology for which a significant production step is the interconnection of enamel-insulated coil wires to connection pads on a circuit board.

Currently, the interconnection is soldered manually for these products due to a lack of automation facilities. Since the process and the geometry of the component are complicated, the manufacturing process can only be reproduced with difficulty. The quality of the solder connection, thus, strongly depends upon the person conducting it. So that the insulating enamel layer is removed from the wire, the hot soldering iron has to be guided over the individual wire several times with a certain contact pressure – this way the insulating enamel melts and the bare

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wire surface contacts the liquid solder immediately. This method is not only time consuming, but also harbors a danger: the section of wire to be connected can tear when very thin self-bonding wires, e.g. $< 100 \mu\text{m}$, are used, or a sound electrical interconnection cannot be established. As an alternative, the stripping of the wire can be conducted chemically or mechanically. Both processes are, however, insufficient – they contain complex process chains and cannot be applied if the subassemblies are miniaturized or if an absolutely necessary process, enamel removal of the wire (e.g. for stripping directly on the subassembly), is integrated into the joining process.

To increase the process speed and reproducibility, the Fraunhofer ILT has developed an automated laser soldering process that not only enhances the manufacturing flexibility, but also offers great potential for further miniaturization. With this process, the enamel removal and the interconnection take place in one single process step. On the one hand, the reproducibility is significantly increased via integrated process monitoring and control based on pyrometric sensors used in the laser-beam soldering process. On the other, the contactless laser soldering process offers significant potential for miniaturization in comparison to competing processes, since the dimensions of the connecting pads can be reduced down to several hundred micrometers. This automated soldering process allows not only a nearly free choice of connection geometries, but also makes manufacturing so flexible that any number of quantities - even individual parts - can be produced without increasing reaction time, as a particular product requires. Medium-sized companies in the sector of electronic manufacturing can clearly fall back on the expertise of the Fraunhofer ILT.

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Caption:

Figure 1: Demonstrator component to solder self-bonding wires on circuit boards. Source: Fraunhofer ILT.

Contact Partners at Fraunhofer ILT

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