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FRAUNHOFER-INSTITUT FÜR FERTIGUNGSTECHNIK UND ANGEWANDTE MATERIALFORSCHUNG IFAM

1 + 2 *The workpiece is adhesively bonded directly to the bench in order to carry out the machining.*

DEBONDING ON DEMAND

A practical vision?

There is often the desire to be able to detach an adhesively bonded joint so that the substrates can be used again, like a screwed fastening. Such debonding would, for example, be useful for recycling the substrates and using them, separated in their single parts, for further applications.

Another scenario is the concept of temporary bonding: When a workpiece is secured for machining it is usually mechanically clamped. An alternative way would be securing via a temporary bond which could then be debonded "on demand".

Requirements of a detachable adhesively bonded joint

- It must – like any adhesively bonded joint – hold under the specific conditions of use.
- The debonding step must only be able to be performed in a controlled way accurately at the time desired by the user.
- The boundary conditions for detaching an adhesively bonded joint must be viable in practice and must comply with health, safety, and environmental regulations.
- Ideally the adhesive should be able to be easily removed from the substrates so they can be used again without complex treatment steps.

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Debonding on demand – The solution of Fraunhofer IFAM

Debonding on demand has been realized with a new adhesive formulation and a special process developed by Fraunhofer IFAM – without stubborn residues of adhesive remaining on the substrates and without high thermal input for debonding the substrates.

The adhesively bonded joint detaches on applying a direct current of 48 V and simultaneously heating the joint to 65 °C. Both conditions are required: Neither the electrical current or heating alone trigger the debonding. This safeguard prevents debonding due to an unintentional signal.

After the treatment, the adhesively bonded joint is greatly weakened. Lap shear tests give the residual strength as 0.1 N/mm².

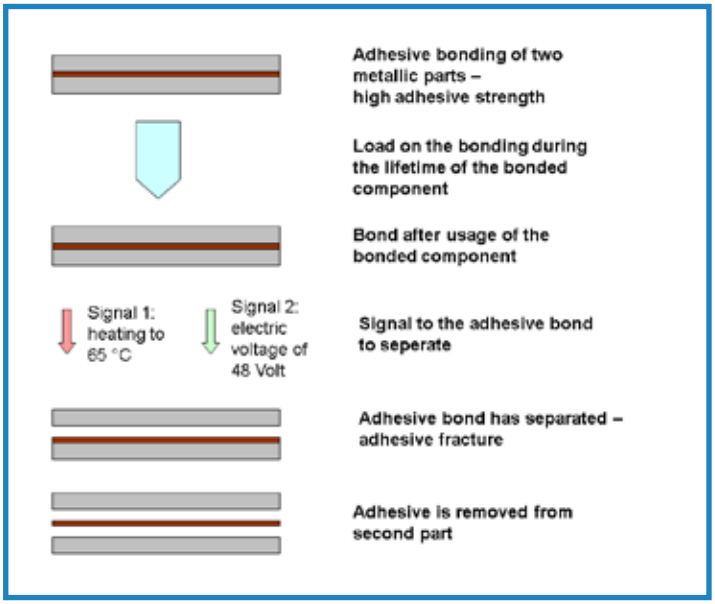
There is adhesive fracture. In the warm state the adhesive can be removed from the second substrate as a closed film, without adhesive residues remaining on the prior adhesively bonded components.

The adhesive had to be specially designed with this functionality. Up until now a polyamide hotmelt has been used. To start with quantities of about 50 g it was prepared in the laboratory. Subsequently there has been successful scale-up to a batch size of 10 kg in the pilot plant of an adhesive manufacturer.

Preliminary tests show that the afore described principle of debonding on demand can be transferred to other classes of adhesives.

Substrate	Strength [MPa]
Steel 1.1203	9.7
Structural steel ST 37	7.0
Aluminum 3.2024	14.2

Achievable strength without pre-treatment of the substrate.



Solution principle for debonding on demand.

3 *After debonding, the adhesive can be easily removed from the workpiece by hand.*