

ADAPTIVE APPLICATION TECHNOLOGIES FOR SMART FACTORIES

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM – Adhesive Bonding Technology and Surfaces –

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Expertise

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM has many years of experience in the field of adhesive bonding technology. It develops customized semi automated and fully automated processes for high-quality, economically viable bonding applications in industry. The focus is on high reproducibility, time-optimized integration of main and secondary processes, and continuous monitoring of process parameters.

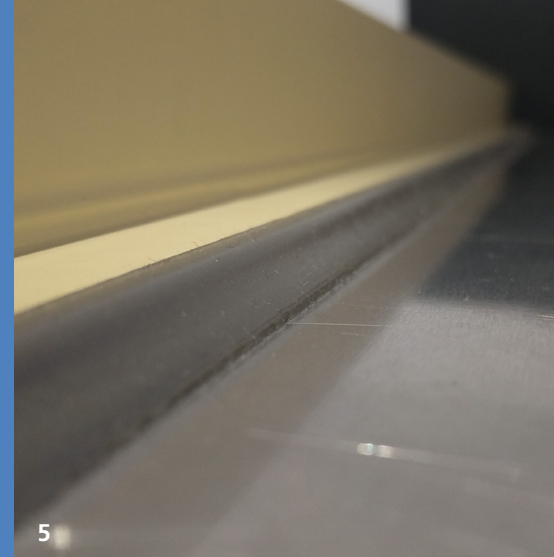
Facilities

The Automation and Production Technology department in Stade possesses a 4000 m² hall for customer-specific process and hardware development work. This means that innovative automation solutions can be tested under real conditions on a 1:1 scale and adapted to the particular

application of the customer. Industrial and lightweight robots with payloads from 10 kg to 270 kg can be combined with a wide variety of measuring systems and tailored software solutions. The use of automated tool changers enables different end-effectors for surface pre-treatment, adhesive and sealant application, as well as quality assurance to be employed (Fig. 1 and 2). Various holding fixtures are available for process development work on original-sized components, both large and small, enabling everything to be optimally positioned, aligned, and processed.

R&D services – automated adhesive and sealing technology

- | Analysis of adhesive and sealing processes
- | Development and testing of application-specific
 - precision adhesive and sealing processes



- end-effectors for processing adhesives and sealants
- Implementation of customized
 - pre-treatment processes – cleaning, abrasion, activation –
 - inline quality assurance systems
- Automated tolerance management for adhesive bonding
- Digital process management and monitoring
- Process implementation for human-robot collaboration
- Process validation on a 1:1 scale

Surface pre-treatment

The pre-treatment of components is absolutely vital in order to ensure ideal surfaces for adhesive application. Fraunhofer IFAM in Stade develops special robot end-effectors for automated pre-treatment tasks. Important here are cleaning processes – usually solvent-based – for degreasing components and activation processes such as the plasma treatment of composite surfaces (Fig. 3). In addition, abrasive processes are used to pre-treat component surfaces. Vacuum sand blasting, an abrasive process that is closed to the work environment, is particularly suitable for many applications and offers new opportunities in automated use (Fig. 4).

Adhesive and sealant application

When manufacturing large components, a huge and growing challenge is the manual processing and application of adhesives

and sealants to meet ever higher requirements. Process automation offers the solution here, fulfilling the requirements for accurate positioning and maintaining of dosing tolerances coupled with ever shorter processing times. A wide range of highly configurable dosing systems are available in Stade so enabling diverse applications to be represented under near-real conditions. The Fraunhofer IFAM experts analyze existing processes at the customer and then develop tailored application processes and specialized nozzle technologies using rapid prototyping methods to reliably meet the most exacting tolerance requirements. Besides classical adhesive bonding tasks, typical practical applications here are especially the sealing of component edges (Fig.5).

Quality assurance for adhesive and sealant application

Users put high importance on the monitoring of bonding processes and their automation. First of all the quality of the surface pre-treatment must be monitored prior to the application of the adhesive/sealant. In parallel with the dosing step, various non-destructive test methods can be used to monitor the application. For example, not only the amount and position of the adhesive/sealant can be monitored inline but also the occurrence of dosing defects such as air bubbles on the surface or inside the adhesive/sealant can be detected.

Digitalization

The ongoing digitalization of production processes, including bonding and sealing, will continue in the coming years and will become indispensable. That is why the experts for Automation and Production Technology in Stade are already working today on new technologies for smart adhesive and sealant application with integrated monitoring. New production-related standards are developed and verified in close collaboration with customers.

- 1 Dosing end-effector being used on a fuselage section.
- 2 Shim application on the tailfin rib of an aircraft.
- 3 Plasma pre-treatment of surfaces.
- 4 Pre-treatment of surfaces via vacuum sand blasting.
- 5 Maskless sealed component edge.