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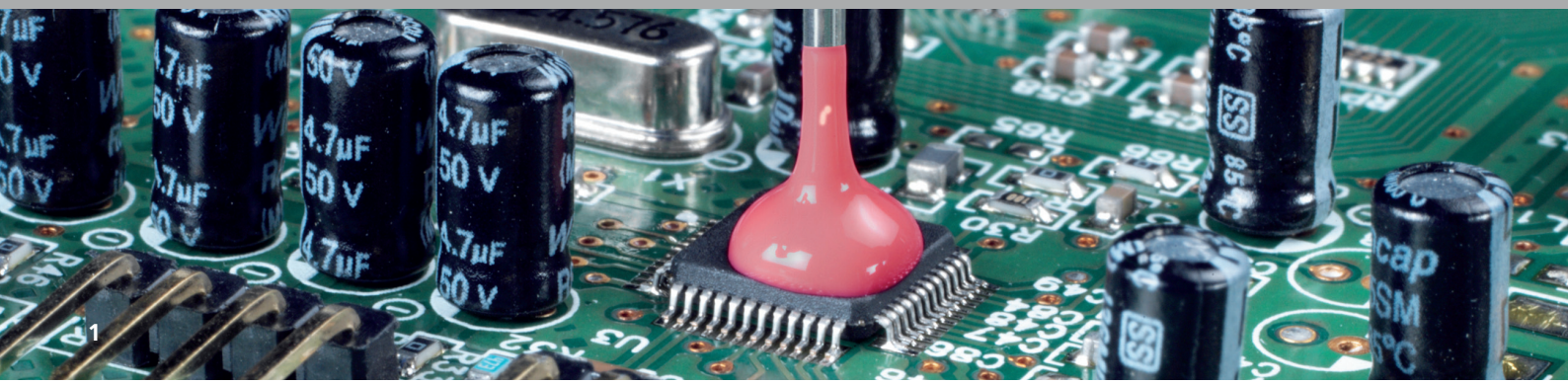

1 *Potting of an electronic component.*

POLYMER POTTING FOR PROTECTING ELECTRICAL SYSTEMS AND ELECTRONICS

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Status quo

The growing number of electronic assemblies and their usage in, for example, cars and sensors is placing increasing requirements on their long-term stability and functional reliability. By potting or by applying protective coatings, the components become completely enclosed and protected by a polymer, so guaranteeing their efficient functioning. With polymer potting protection up to class IPX9 (protection against water during high pressure steam cleaning) can be achieved.

The most important functions of potting compounds/protective coatings:

- Heat removal
- Mechanical protection
- Protection against penetrating media
- Electrical insulation

There are ever increasing requirements with regards to moisture resistance, temperature resistance, temperature shock, electrical insulation, and heat conduction.

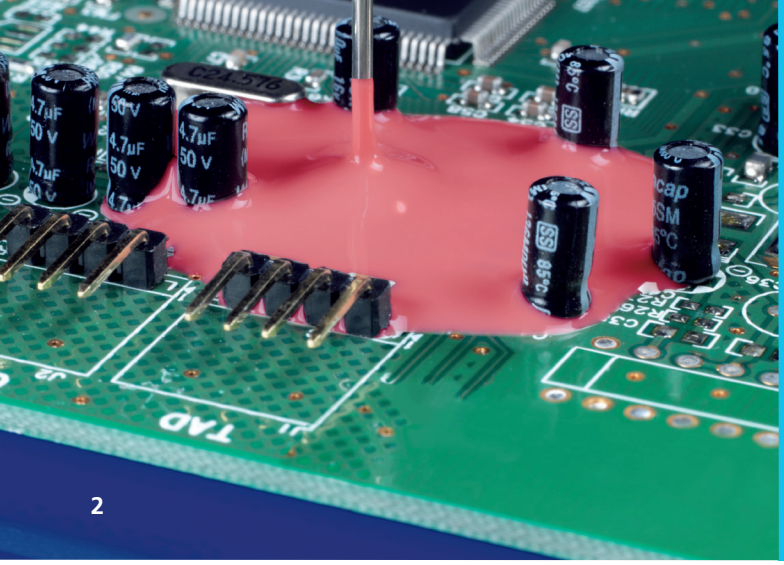
Common problems with potting

- Internal stresses in the potting compound can lead to debonding, cracks in the potting, up to the breaking off of electronic components
- Defects introduced by the process, for example cavities and incomplete curing, with subsequent penetration of moisture and functional impairment/ corrosion

The coating of the assembly is usually the last step in the value-creation chain. With errors here having high cost implications or leading to unfavorable results in the field.

Fraunhofer IFAM – material selection, process development, and consultancy

Fraunhofer IFAM is your service partner in the area of potting: the pointed approach enables you to shorten development times already within the planning and guarantee reliable product functionality.



A holistic consideration of all material as well as production influences and their mutual interactions is necessary here. This requires the use of, amongst other things, tools for simulating the filling process (Computational Fluid Dynamics; CFD) and for predicting internal stresses (Finite Element Method; FEM) along with analytical techniques for measuring relevant material parameters.

Services

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM supports your company in all stages of the production process: from the selection of potting compounds, to production concepts, and right through to inline monitoring the quality of the products.

- **Casting compounds / Protective coatings**
  Selection, development and modification of polymers to meet customer-specific requirements; characterization in the non-cured and cured state using rheological methods, thermal analysis, and IR spectroscopy, quality assurance
- **Design**
  Analysis of loads and internal stresses using FEM, determination of thermo-mechanical and mechanical parameters
- **Pre-treatment**
  Cleaning and pre-treatment methods for optimizing adhesion (plasma pre-treatment, CVD adhesion promoting layers, CO_2 snow jet cleaning, lasers, etc.)
- **Quality assurance**
  Substrate and surface characterization, including inline methods (process monitoring)
- **Production concepts**
  Plant selection, application and dosing of casting compounds
- **Potting process**
  Process optimization, troubleshooting, simulation of filling (computational fluid dynamics), consultancy on integration into the production
- **End properties**
  Testing the resistance to operating loads, media, and climatic stresses
- **Failure analysis**
  Contamination, penetration/corrosion, breaking off of components, debonding, formation of stress cracking

Pottings techniques at Fraunhofer IFAM

- **Manual potting**
- **Automated potting**
  - → under normal pressure
  - → under continuous or discontinuous vacuum
- **Protective paints and plasma coatings**

Analytical equipment

- Material characterization via DSC, TGA-MS, IR, rotational rheometer, TMA, DMA, laser flash method (heat conduction)
- Mechanical tests (quasi-static, dynamic, highly dynamic, fatigue strength)
- Various special methods, e.g. for measuring reaction shrinkage, water uptake
- Vacuum potting chamber
- 1-C and 2-C dosing system-test facility
- Microdosing and micropositioning systems
- Various dispersing and synthesis techniques
- Surface analysis via XPS, AES, TOF-SIMS, electron microscopy
- Atmospheric pressure and low pressure plasma techniques, pyrosil technique, CO_2 snow jet cleaning, lasers
- Climate chamber
- Test loop for determining the stability of individual components to shear
- X-ray computer tomography for detecting inclusions, cavities, etc.
- Dielectric analysis (DEA)

2 *Partial potting of a printed circuit board.*
3 *Corrosion on a damaged printed circuit board.*