Friedrich-Alexander-Universität
Erlangen-Nürnberg

LEHRSTUHL
FÜR KUNSTSTOFFTECHNIK
Prof. Dr.-Ing. Dietmar Drummer

Media-Tight Hybrid Systems

Motivation

Tightness is a key requirement in many technical components that come into contact with media such as water, oil or dust during application. A particular challenge is the pairing of different materials (metal, ceramics, polymers). In many cases, these combinations are incompatible with each other. Accordingly, suitable pretreatment must be applied to ensure adequate bonding. Further challenges arise from the material pairing due to strongly differing properties (e.g. thermal expansion) and external loads, which must be systematically investigated using variable specimen geometries for tightness testing (Fig. 1).

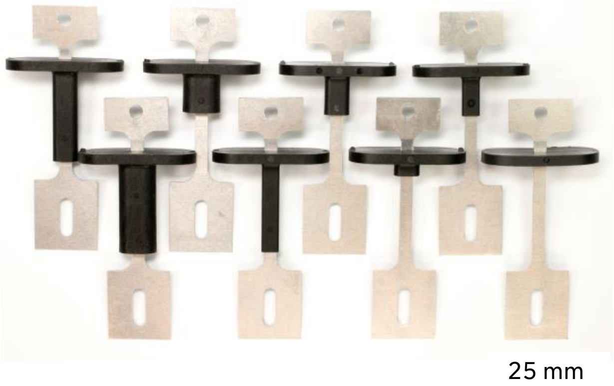

Fig. 1: Modular specimen for leckage testing at LKT

Application

A typical field of application for media-tight hybrid systems is electronic assemblies such as sensors and circuit boards. Due to increasing automation, these are being used in every new area of application, in which they are confronted with increasingly high loads. These include thermal, mechanical and media-bearing loads such as oil, water or dust. Accordingly, efficient protection achieved in a process suitable for large-scale production is of key importance. Injection molding can meet these encapsulation requirements, but brings the additional challenge of a possible damage to the electronics due to the high pressures during the process (Fig. 2).

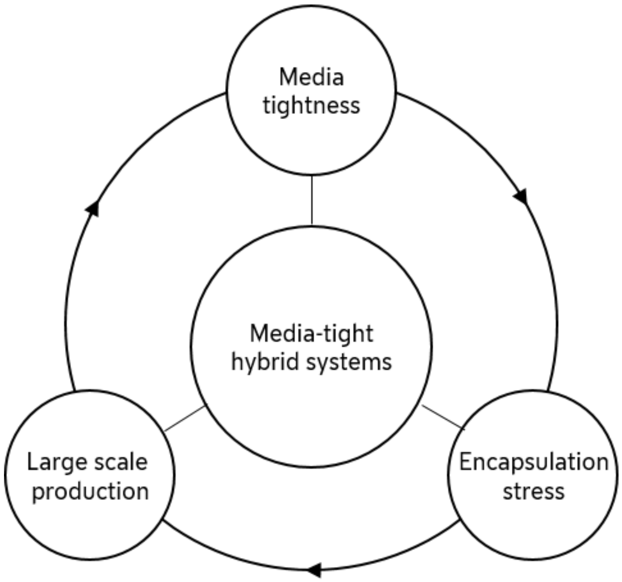

Fig. 2: Challenges for media-tight hybrid systems

| Institute of Polymer Technology
| Am Weichselgarten 10 | 91058 Erlangen-Tennenlohe, Germany
| Phone: +49 9131 85 710 00 | Fax: +49 9131 85 710 07
| Mail: lkt-info@fau.de | https://www.lkt.tf.fau.eu/

Research focus

The Institute of Polymer Technology (LKT) current focus in this area is on realization of a media-tight, low-stress encapsulation of electronics using foam injection molding. This material and process modification is intended to reduce the focus in the mechanical load to the electronics caused by the melt flow during processing and at the same time achieve high media tightness. The systematic investigation of the loading effect is realized by means of in-situ measurement technology and its prediction by a process simulation. In the area of tightness, the focus is on initially tight components with and without pretreatment as well as on the mapping of leakage under practical loads, including in the area of polymer-metal hybrids.

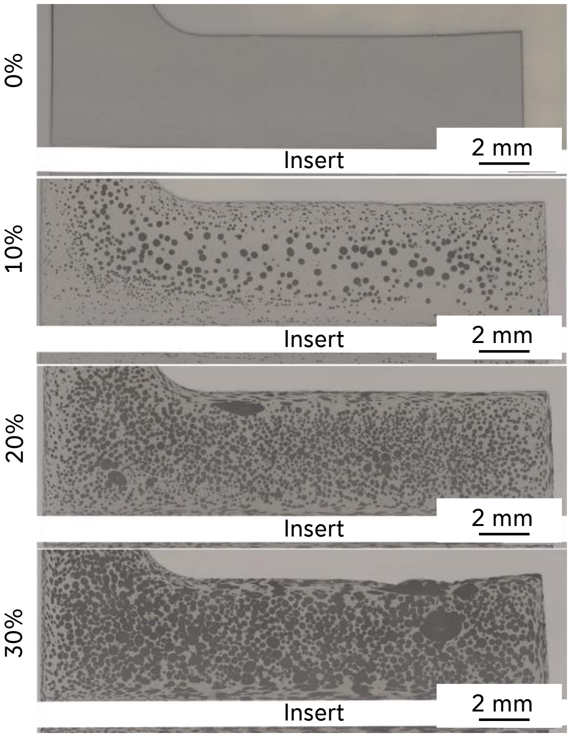

Fig. 3: Microscopy images of foam-coated inserts

Main research results

It was shown that thermoplastic foam injection molding can be used to encapasulate insert parts (Fig. 3) In addition, foaming can be used to fabricate reproducibly tight components, which exhibit higher tightness than conventionally injection molded components, even without pretreatment (Fig. 4). It can be seen that very low leakage rates are achieved for 10 % and 20 % foamed components. Similar results were also obtained with metallic inserts. In addition to these findings, it was shown that the shear and compressive stresses occurring during the encapsulation of electronics can be significantly reduced by foaming. Furthermore, measurement setups for in-situ tightness measurement and for in-situ stress measurement has been realized sucessfully. Currently, the focus is on separating the effects clearly and generalizing them with respect to process and material parameters.

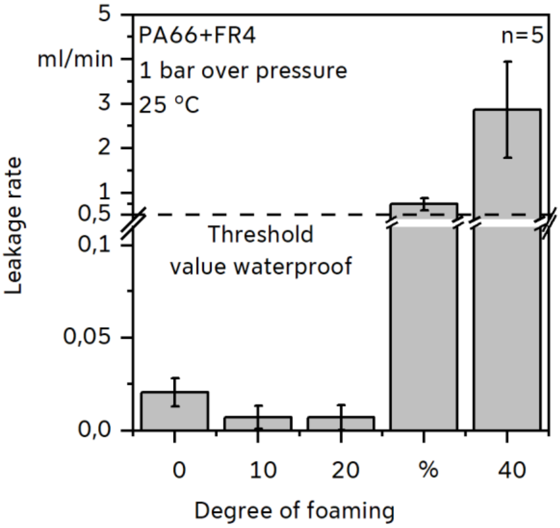

Fig. 4: Results of the leak test of foamed components