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Quality control and process observation for the micro assembly process

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Abstract

The automation of micro assembly is becoming more and more important in micro technology. Especially the demands on handling and process observation of hybrid microsystems with optical and mechanical functions are quite high. Because of this process monitoring is inevitably necessary for a better understanding of what is really happening in the micro world. Process visualisation is very important in MEMS (Micro Electronic and Mechanical Systems) but does not guarantee an operative micro system. Therefore, instruments for quality control are required to secure a safe and reproducible assembly. The aim of this article is to illustrate the need for inspection systems. Also to give an overview over used and new devices for process observation and quality control. Finally, a newconcept of a modular in-line observation system (MILOS) is presented.

Keywords: MEMS; Process observation; Quality control; Microscope; Micro assembly; Confocal microscopy; Atomic-force-microscope; Scanning-probe-microscopy; Ultraobjective; Interferometry; Scanning-electron-microscopy; Fibre-scopes; Fibre-optic sensors

1. Introduction

The meaning of microtechnology as a new and innovative technology has increased in the last years. Micro products open up new vista in many fields (sensors, medical applications, optoelectronics etc.). Micro systems also will guarantee the success of products in all important industrial sectors. In spite of the good prognosis many potential users and manufactures avoid the investment in this new technology. The production technology is deemed to be the main reason for this reservation. Another barrier represents the high acquisition and running costs and the missing knowledge on the production process. The manageable manufacturing of specific micro parts, an adapted assembly with suitable mounting and joining technologies and the availability of cost-efficient micro components is the key for a successful assembly of micro systems.

A permanently increasing market for micro systems has established by the while [1]. For example, pressure sensors are fabricated industrially and are used in various products of daily life. But the breakthrough for the micro-system-technology will be the production of hybrid micro systems economically. Hybrid micro systems can be found in different industrial areas. For example, in the field of communication technology micro systems have to

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build up for the optical data transfer. In medical engineering new fibre-scopes with different functionalities are required. Furthermore, micro engines and micro pumps are developed to provide ball bearings with lubrication-films that will be implanted into the human body.

As mentioned before the combination of different manufactured micro parts need suitable mounting and joining techniques. This enables the assembly of complex hybrid micro system with electronic, mechanical, optical, biological or chemical components. Just the gap between available techniques and devices and future requirements on the assembly of non-electronic components is wide. There is an urgent call for action for fundamental research in this field to achieve a great progress and guarantee a successful use of micro systems in the next years.

For this reason a collaborative research centre (SFB) called 'Assembly of hybrid micro systems' was founded in Germany in 1997 by the DFG (Deutsche Forschungsgemeinschaft). In this project different institutes work together to solve basic questions in handling and joining processes. Thereby, not the micro system itself but the integration of hybrid micro parts in a functioning total system is the focus of the project.

2. Measurement tasks in the field of micro assembly

Metrology plays an important role within the microtechnology. In contrast to the macro world humans cannot sense the microproduction-processes with their sensory organs. Therefore, measurement is essential, because it is the only access to the micro-dimension. Through metrology new fields are opened up, in which humans are blind or deaf. Parameters can be measured which are out of our experience like the diameter of atomic nucleon.

Quality control in the field of microtechnology has not been established yet. As a basic principle in micro-metrology is divided into four parts: material testing, completeness check, dimension and position measurement and function test.. The metrological tasks are used mainly for three various components: electronic components, optical components and mechanical components (Fig. 1). Whereas the material and functional tests and also the material testing relates to all parts of microtechnology, dimension and position measurement is only for mechanical components suitable. A completeness check is used for optical and mechanic components.

Nearly 90% of the required measurement tasks can

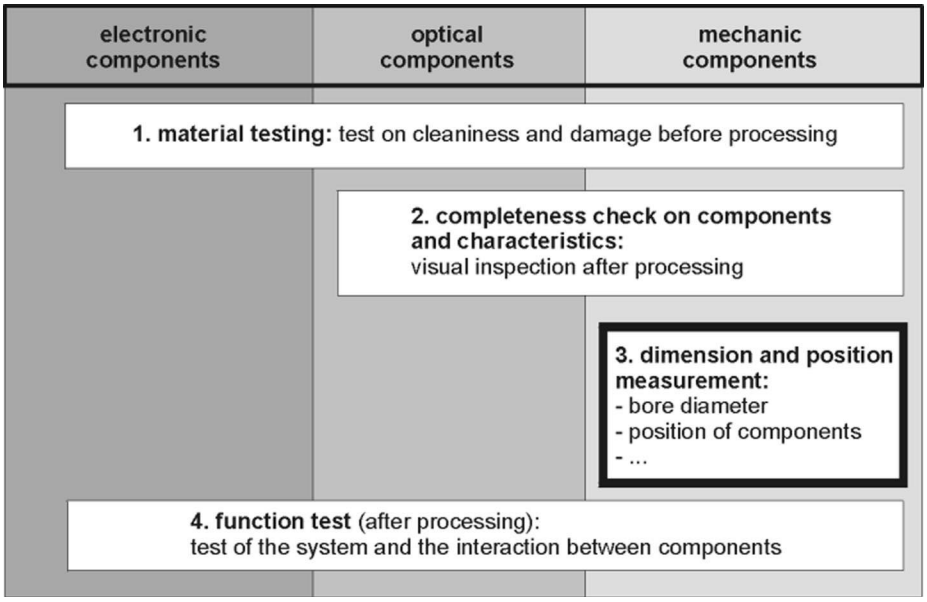

Fig. 1. Measurements tasks in the field of microtechnology.