HORIZON 2020

# In-line quality inspection system for smart production of micro and nanoelectronic components

## Reporting

Project Information

**INLINETEST**

Grant agreement ID: 780832

Project website

**DOI**
10.3030/780832

Project closed

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21 September 2017

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1 January 2018

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INDUSTRIAL LEADERSHIP - Leadership in enabling and industrial technologies - Information and Communication Technologies (ICT)

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**EU contribution**
€ 1 332 916,88

**Coordinated by**
BERLINER NANOTEST UND DESIGN GMBH
Germany

## Periodic Reporting for period 2 - INLINETEST (In-line quality inspection system for smart production of micro and nanoelectronic components)

**Reporting period:** 2019-07-01 to 2021-11-30

### Summary of the context and overall objectives of the project

Micro- and nanoelectronic components are one key driver of today's industrial growth and have been pervading nearly every domain of modern society and life, tendency: increasing. In order to be competitive on these markets, components need to have high quality, i.e. be reproducible, robust and reliable under given environmental conditions. These quality issues are to a great deal determined by their production processes: This is where tolerances, flaws and defects are induced which are responsible for early malfunction of failure in field operation. The key to highest productivity at highest yield and lowest cost is 100% in-line inspection during production, to gain intimate knowledge about interdependencies between process steps and process parameters. Therefore, INLINETEST targets the design, realization, deployment and test of two novel in-line inspection systems for micro/nano-electronic components.
The consortium consists of 5 partners from 3 European countries and integrates competence from 1 big company, 3 SMEs and 1 university. Moreover, three global players in micro/nano-electronics in Europe accompany this endeavor on the board of industrial advisors. In this way, INLINETEST project will make use of all partners' complementary competencies and push the technology a big leap forward to the market.

## Work performed from the beginning of the project to the end of the period covered by the report and main results achieved so far

Thermometric methods have high potential for fast, contactless and non-destructive full-field failure analysis. In the project, Infrared Thermography (IR) and Thermoreflectance (TR) are exploited for the first time to enable 100% in-line production monitoring. This will be done by adapting and upgrading existing lab-scale systems for both methods to the challenges of real-life in-line testing, enhanced by hard- and software innovations. Depending on the specific measurement requirement (defined by the sample), different camera systems (high performance or cost optimized) and excitation sources (flash, laser, etc) are selected to create a suitable system. Camera systems are purchased from external suppliers, while various excitation sources are developed and tested within the project. A completely new device, a compact combination of flash excitation with integrated IR camera called FlashCAM is another achievement, which in turn is used in a specially designed production line simulator. With this simulator the complete interaction of the FA solution (hardware, software and outher data management system) can be tested. For validation under real-life conditions, both failure analytical method's hard- and software will be customized and integrated into production lines and demonstrated on six different applications ranging from encapsulated chips to sintered power modules on AMB to RF-MEMS and monolithic power amplifiers in GaN.

## Progress beyond the state of the art and expected potential impact (including the socio-economic impact and the wider societal implications of the project so far)

Whereas fast automated in-line equipment is available on the market, the bottlenecks are the respective measurement systems and the real-time data processing. Many methods are too slow to keep track of the production. And electrical response signals do not reveal a spatially resolved map of

structural deviations from the standard, but a temperature contrast detected on thermal reflective surfaces could.
Propagating thermal waves probe the heat path in the component which is determined by the material structure properties. Aberrations or anomalies can thus be made visible by recording the thermal signature of the component (surface temperature over time) as response. The methods used for recording, PIRT or TR, are complementary in the sense that PIRT is sensitive for non-reflective surfaces (e.g. encapsulated components) whereas the other, TR, is sensitive to reflective surfaces. So many stages in the production process can be monitored. One major advantage is that the equipment probes exactly those flaws which are responsible for a later failure by the same physical effect of high temperature. So the thermal contrast detected is physically very motivated and justified and better suited than other methods, e.g. acoustic reflection or absorption of radiation. Further, cooling down time (tens of seconds) after processing can ideally be used for thermographic methods as it is not used otherwise.
The in-line inspection systems based on combined PIRT and TR will be demonstrated in a real industrial environment on a production run featuring a large number of micro/nano-electronic components, exemplified on power multi-chip modules from the industrial sectors of RF systems (GaN) and automotive (Si), as well as a sintering process.

Project Logo

**Last update:** 3 June 2022

**Permalink:** https://cordis.europa.eu/project/id/780832/reporting