PROJECT PROFILE

20014

Additive Manufacturing based Production of Embedded Robust Electronics [AMPERE]

Current manufacturing production is optimised for high volumes of low cost, high quality products. Yet, as digitalization and Industry 4.0 (Smart Industry) expand, the drawbacks of this conventional manufacturing become clear. In particular, it leads to a lack of flexibility and highly standardised designs and components. The AMPERE project will develop reliable and scalable digital 4D manufacturing methods with embedded robust electronics. By combining Additive Manufacturing (also known as 3D printing) and the fourth dimension – the addition of electrical and optical functionalities, AMPERE aims to enable flexible, reliable production of smart systems with relevance for Industry 4.0 and smart industrial processes. These in turn will allow for new functionalities beyond those possible with conventional fabrication techniques in areas such as lighting, signal and power electronics, and medical devices.

Worldwide, the market for electronic products and manufacturing is evolving at unprecedented speed and in disparate directions, demanding optimized and customized solutions. This market is being shaped by increasing digitalization and in Europe, the industrial response to the ever-increasing digitization of society is found in initiatives such as Industry 4.0 which make intensive use of ICT. Such Smart Industry initiatives rely not only on ICT (data collection and analysis, sensor data, connectivity and IoT approaches), but also address the physical aspects of manufacturing such as Additive Manufacturing (AM) together with smart automation/robotics.

As these changing demands emerge, they are highlighting the limitations of current manufacturing infrastructure with its focus on mass production, much of which is in Asia. Specifically, this mass production has led to standardized components and designs, limited shape freedom, a rigid supply chain and pressure to minimize variation as associated fixed costs need to be amortized over many produced units.

AM techniques have the potential to enable flexible manufacturing processes better suited to the new demands of a digitalized society and smart industry. It could allow for the production of a wide range of mechatronic end-products. However, for this, the individual and combined processes, quality standards, reliability and integration with current methods need to be brought to a higher maturity level.

Bringing flexibility to mass manufacturing

AMPERE is responding to this challenge by creating new integrated manufacturing processes that enable 4D integration of mechanical, electrical, and optical functionalities into end-products. The project has four key objectives:

1. Develop and integrate Essential Technology for scalable hybrid 4D manufacturing that is both flexible and cost-effective, from small series mass customization through to higher production volumes whilst meeting the real needs of industry...
2. ... through digital Smart Processes of 4D products (integrated mechanical, electrical and optical functionalities)
3. Develop scalable and reliable Industrial Production Systems in combination with the essential technology and smart processes
4. Demonstrate the hybrid 4D manufacturing approach in three innovative product cases covering different applications and sectors: LED luminaires, signal and power electronics, medical devices.

AMPERE will deliver hybrid multi-material AM production methodologies, a demonstrated integrated production environment architecture, and prototypes of mechatronic products in the three application areas made using the hybrid manufacturing process. Besides multi-material AM

KEY APPLICATION AREAS

- Health & Well-Being
- Energy
- Digital Industry

ESSENTIAL CAPABILITIES

- Process Technology, Equipment, Materials and Manufacturing for Electronic Components & Systems

PARTNERS

Eindhoven University of Technology
Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.
Neotech AMT GmbH
Philips Electronics Nederland BV
Reden BV
Signify
TNO
VSL BV
Würth Elektronik eiSos GmbH & Co.KG
XENON Automation GmbH

COUNTRIES INVOLVED

- Germany
- The Netherlands

PROJECT LEADER

Johan Klootwijk
Philips Electronics Nederland BV

KEY PROJECT DATES

Start: 2021-04-01
End: 2024-03-31

as a core production technology, the hybrid process will combine assembly and integration of electronic and optical functionality. Closed loop control utilising machine learning and artificial intelligence will also be an integral part of the complete production chain.

This hybrid approach offers significant business benefits including the ability to respond faster to changes in the market, increased product diversity, and cost-effective scalable manufacturing – from customer-centric (semi-bespoke) parts through to high volumes with features such as optical functionality, current carrying capability and miniaturized devices. Overall, this will allow new product designs offering improved functionality and new form factors not possible previously.

In lighting, it will enable combinations of shapes, optics, sensors and electronics to create new ambient experiences, connected lighting, and distributed electrical components (LEDs, drivers). For signal and power electronics, the results will allow increased system integration and more compact design, integration of board functions into housings, material savings, reductions in the number of steps in the production process, and an extension of the functions to power over data line. In medical devices, mechanical support combined with integrated electrical and optical functionality will allow the creation of ever-smaller, smart minimally invasive instruments.

Comprehensive expertise

Close cooperation across the entire value chain is key to achieving AMPERE's ambitions. Thus, the AMPERE project partners cover the whole range of necessary technical competences, as well as the complete value chain of materials, processes, equipment, product design, manufacturing, and applications.

Multi-billion euro markets

AMPERE's market impact will cover new materials, processes and smart equipment, software and simulation tools, and knowledge-based design tools, along with the integrated mechatronic end-products. It is also addressing several key aims of Industry 4.0 initiatives including resource efficiency, improved quality, customization and local production through the integration of multiple processes and products, including hardware and software platforms. In doing so, it will produce outcomes at the intersection of three multi-billion Euro markets: AM, printed electronics, and traditional manufacturing. The AM market is a dynamic, rapidly growing market (21% from 2017-2018) valued at USD 10 billion in 2019. 3D printed electronics is likewise a growing sector, expected to reach a total value in excess of USD 2 billion by 2029. Meanwhile, the global market for Electronic Manufacturing Services was USD 463.2 billion in 2019 with annual growth currently exceeding 10%.

AMPERE's market potential builds on Europe's existing strength in high quality equipment, materials and products and extends these to the digital domain. It will ensure European leadership in designing for digital manufacturing and digital service design. European electronics manufacturing companies will be able to retain their leading positions in the rapidly changing market for traditional electronic products and to compete in the emerging field of mechatronics with optimized solutions.

In the future, 4D manufacturing will play a key role in allowing customized and scalable production in Europe. It will not only enable manufacture of innovative products but also potentially pull back an important portion of the electronics manufacturing value chain to Europe. Tools and equipment developed in this project will be unique and help shape the future of microelectronics production worldwide. In short, by integrating manufacturing more closely with the design cycle, AMPERE will support Europe in creating world-leading capabilities sustainable for the long-term.

[1] Wohlers Report 2018
[2] 3D Printed Electronics and Circuit Prototyping 2019-2029, IDTechEx
[3] Electronic Manufacturing Services Market Analysis and Global Outlook, Beroe Report 2019

Aeneas Office
44 rue Cambronne
F-75015 Paris - France
Tel. +33 1 40 64 45 80
Fax +33 1 40 64 45 89
Email penta@aeneas-office.org
www.penta-eureka.eu

Penta (E! 9911), is a EUREKA Cluster whose purpose is to catalyse research, development and innovation in areas of micro and nanoelectronics enabled systems and applications.