NANOMEND

METROLOGY FOR ENHANCED NANO-SCALE DETECTION, CLEANING AND REPAIR

Enhanced in-line detection, cleaning and repair of nano-scale defects in thin films

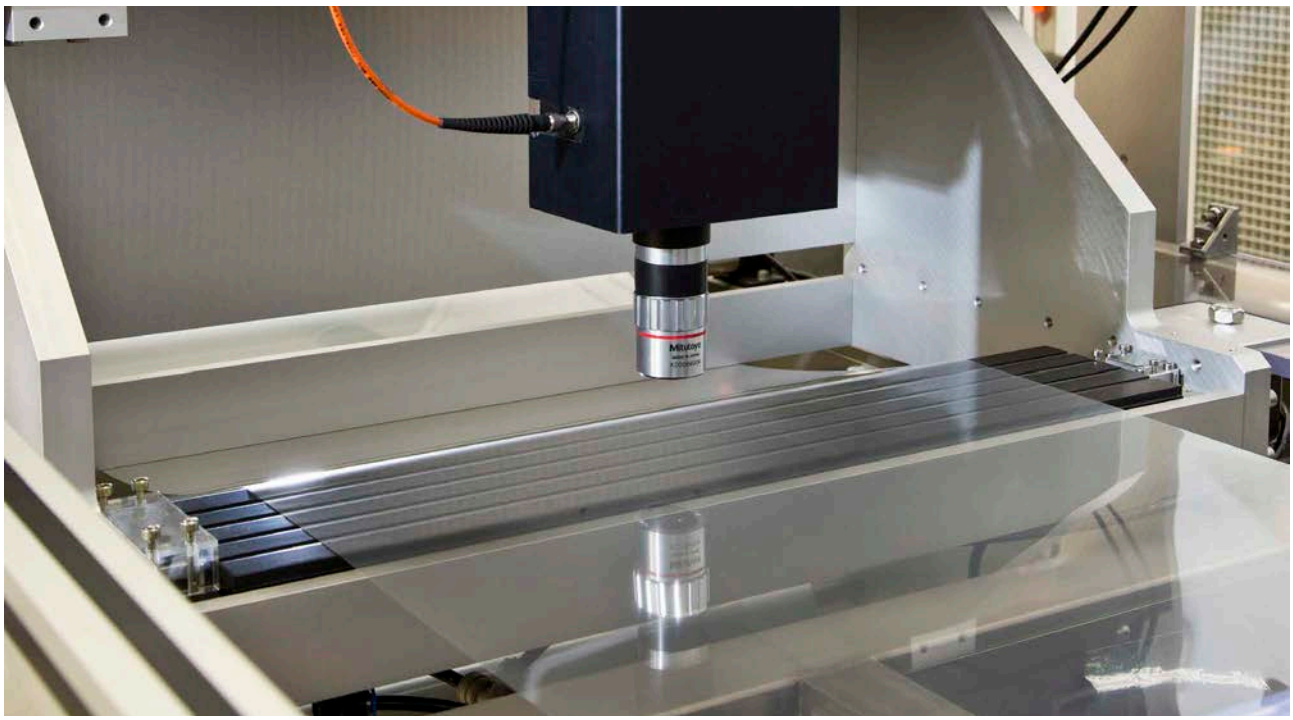
for flexible photovoltaic and food packaging applications

A European collaboration bringing together world class expertise from industry, technology and academia

About NanoMend

NanoMend is an industry-led collaboration that is developing pioneering technologies for in-line detection, cleaning and repair of micro and nano-scale defects on thin films used in applications such as flexible photovoltaics and paper-based food packaging films.

Comprising of 14 partners across 6 European countries, the project brings together world class capability in industry, technology innovation and academia with the aim to upscale and integrate pioneering technologies into systems that work at the speeds required for industrial applications. The €7.25 million project is funded from the seventh framework programme of the European Union.



The Need for Defect Detection in Thin Film Manufacturing

Defects can occur at a number of different stages in the manufacturing process and can be caused by anomalies, such as contamination and thickness variations in the film. For example, the occurrence of micro and nano-scale defects in barrier films can allow water vapour to enter flexible solar modules, which is highly detrimental to their performance and lifetimes. Defects also allow gases to enter or leave food packages, which significantly impacts product shelf life. Most thin film coatings for industry are produced at high speed using roll-to-roll manufacturing techniques. These systems require specialist high speed and high resolution equipment to detect and correct any defects in production.

NanoMend will provide integrated detection, cleaning and repair systems for micro and nano scale defects at the roll-to-roll production scale. During the project, two distinct approaches will be developed in order to demonstrate how NanoMend technologies can be integrated into the paper, packaging and flexible photovoltaics markets. The first approach will encompass a demonstrator system being situated at the Swiss manufacturer of flexible CIGS solar modules, Flisom AG and a proof of concept system situated at CPI in the UK where the system is applied to the manufacture of ultra barrier films. The second area of application will be a demonstrator system at Tampere University of Technology (TUT), Finland. TUT produce polymer coated packaging products in collaboration with the Finnish paper, packaging and wood products producer Stora Enso.

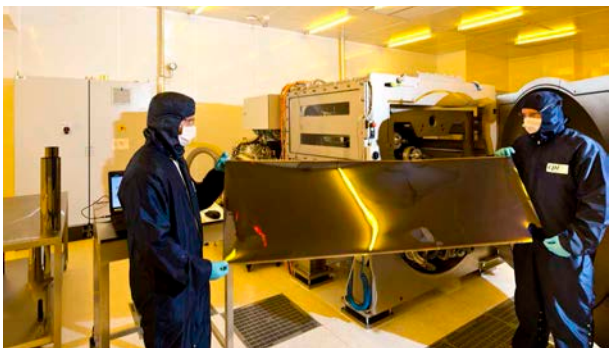
Technologies

NanoMend aims to develop technologies that can detect and correct micro and nano-scale defects within films that have thickness from several micro-meter to tens of nanometers, without reducing production efficiency. The technologies will significantly enhance film quality, yields and lifetimes as well as minimising manufacturing costs and materials wastage.

The project will assess the economic feasibility of these technologies by providing the expertise and capability to test and develop the technologies from lab scale through to roll to roll processes at pilot production scale.

NanoMend's key technologies are:

- High speed optical inspection system
- Wavelength Scanning Interferometry
- Novel Gas Cleaning for Paper and Photovoltaic Substrates
- High Sensitivity Water Vapour Transmission Rate Measurement
- Atomic Layer Deposition



Markets and Applications

NanoMend technologies can be applied to improve the manufacturing of a wide range of thin film products such as printed electronics, food packaging, conformable solar panels, flexible display screens and lighting.

The NanoMend project is focused on two application areas:

Paper Packaging for Foods

The need to cut manufacturing costs and address environmental concerns is leading to a reduction in the volume of polymer used to coat paper and for packaging products. However the reduction of polymer poses a problem for manufacturers as thinner polymer films are more sensitive to defects. Utilising NanoMend's specialist defect detection technologies, the project will seek to significantly reduce the incidence of defects in polymer films at pilot production scale, giving rise to the market adoption of high quality coated paper packaging for food products that are produced in an environmentally friendly and economically sustainable manner.

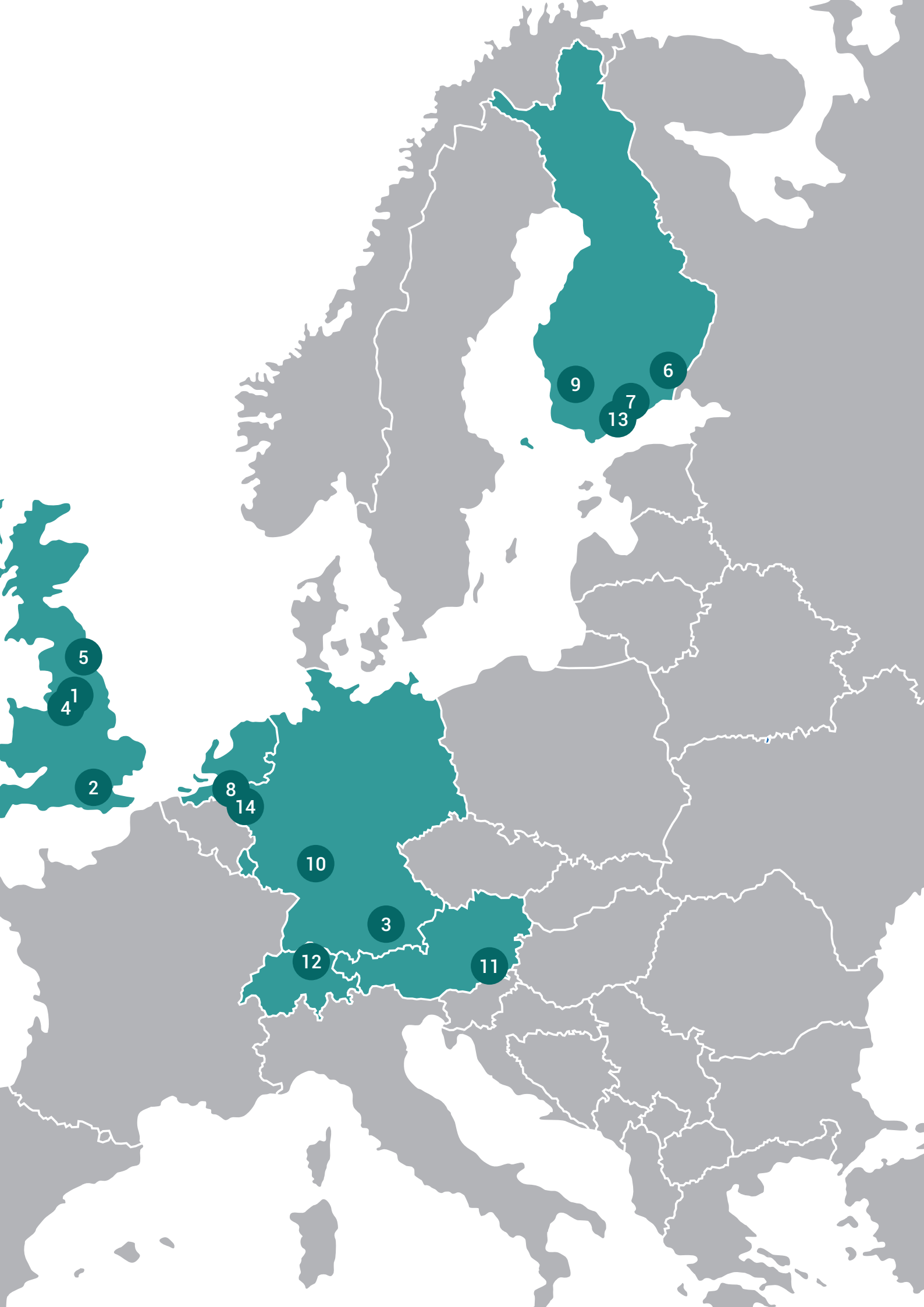
Flexible Photovoltaics

Innovations in solar technology mean that in the future energy generation from the sun can be produced with ultra thin, remarkably lightweight and flexible photovoltaics. Flexible photovoltaics will be highly suitable for applications where weight reduction and shape is important. Future advances in flexible photovoltaic technology will enable designers to apply solar energy to a number of applications ranging from buildings, windows and marquees to clothing, packaging and lighting products.

However, the occurrence of micro and nano-scale defects in production substantially impacts upon the performance and lifetimes of flexible photovoltaics and is a major obstacle in the commercialisation of the technology. NanoMend is developing cost-effective technologies that detect clean and repair defects at the scale and speeds required for industrial manufacturing. These technologies will increase the affordability of new solar technologies as well as improving their longevity and reducing waste.

NanoMend Consortium

1. **University of Huddersfield** – Huddersfield, UK
2. **National Physical Laboratory** – Teddington, UK
3. **Fraunhofer-Gesellschaft** – Munich, Germany
4. **KITE Innovation** – Huddersfield, UK
5. **CPI** – Sedgefield, UK
6. **Lappeenranta University of Technology** – Lappeenranta, Finland
7. **Stora Enso** – Helsinki, Finland
8. **TNO** – Eindhoven, The Netherlands
9. **Tampere University of Technology** – Tampere, Finland
10. **ISRA VISION AG** – Darmstadt, Germany
11. **ISOVOLTAIC AG** – Lebring, Austria
12. **Flisom** – Duebendorf, Switzerland
13. **Iscent Oy** – Vantaa, Finland
14. **IBS Engineering** – Eindhoven, The Netherlands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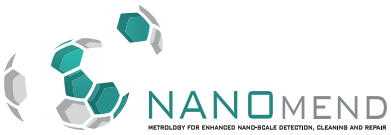

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