European research project successfully demonstrates laser structuring of large surface areas to produce materials with fluid repellent and anti-bacterial effects.

The EU TresClean project has successfully completed its mission to demonstrate that tailored surfaces replicating the types of organic structures found in nature can produce beyond state-of-the-art fluid-repellent and antibacterial surfaces.

The project identified the following laser surface treatment technologies as the most suitable techniques for producing fluid-repellent surfaces, Laser Induced Periodic Surface Structures (LIPSS) and Direct Laser Interference Patterning (DLIP). These techniques were employed to produce proof-of-concept hierarchical surface structures with specific micro- and nano-scale features that were shown to be superhydrophobic (fluid-repellent) and antibacterial, with a > 90% reduction in cell adhesion achieved under controlled conditions.

Structuring large areas with the DLIP and LIPSS processes was a major challenge for TresClean as existing materials processing machines did not offer the power or speed required for high-throughput production. To enable scaling up of the techniques the project developed and validated new high-power laser sources and high-speed scanning heads that could produce surface structures with a laser repetition rate of up to 10 MHz at scanning speeds of up 200 m/s within a field size of 200x200 mm. When integrated into materials processing machines, this technology allowed TresClean to successfully generate functionalised surfaces on free-form metal components and to transfer nanoscale topographies onto plastic parts during injection moulding.

Initial laboratory tests to evaluate the cleanliness and hygiene of the metal components and plastic parts textured with the TresClean production processes produced promising results indicating improved antibacterial performance of the textured surfaces compared with untextured parts, with metal parts performing better in tests than plastics. This was further confirmed in initial life cycle and durability testing which found that metal parts structured with DLIP and LIPSS processes had improved wettability and cleanability compared with untextured components.

TresClean Coordinator Professor Luca Romoli shared his thoughts about the project: “At the end of a very intense research period, the project has brought laser texturing out of the lab and contributed to tailored photonics solutions in a very innovative field. An antibacterial effect was demonstrated for surfaces textured with LIPSS and DLIP technologies, showing how effective texturing could be in enhancing the service life of components for agrifood machinery and home appliances. Laser texturing, characterised by surface features only a few hundred nanometres in size, was achieved over areas larger than one square meter to induce unique functionalities such as antibacterial and self-cleaning behaviour. The scanning system specifically conceived within TresClean achieved speeds of several hundred m/s, which translates to processing times that are of real industrial interest. The project was a challenging opportunity for all of us and I hope its results will find fast industrial exploitation. We had numerous queries from companies interested in exploring TresClean technology, both in relation to direct texturing and injection moulding, which makes many possible applications come to mind within a very large range of industrial scenarios. The TresClean project is an initiative of the Photonics Public Private Partnership but has triggered interest over a much broader area of expertise, demonstrating that photonics is an enabling technology for innovation and competitiveness.”

TresClean was delivered by a European consortium comprising 7 partners from 5 countries:

Università degli Studi di Parma (UNIPR - Italy),
Universitaet Stuttgart (USTUTT - Germany),
Centre Technologique ALPhANOV (ALPhANOV - France),
Raylase GmbH (RAYLASE - Germany),
Ecor International (ECOR - Italy),
BSH Electodomesticos España SA (BSH - Spain)
Modus Research and Innovation Ltd (MODUS – UK)

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Horizon 2020 is the biggest EU Research and Innovation programme ever with nearly €80 billion of funding available over 7 years (2014 to 2020) – in addition to the private investment that this money will attract. It promises more breakthroughs, discoveries and world-firsts by taking great ideas from the lab to the market. TresClean is an initiative of the Photonics Public Private Partnership, www.photonics21.org.

For further details about the project, please visit TresClean’s website www.tresclean.eu.

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