Deliverable

WP5 – Dissemination and exploitation

D5.3 Project Newsletter (2)

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Executive summary

1 Executive summary

1.1. Description of the deliverable content and purpose

Deliverable 5.3 is related to the creation of the second PULSE-COM newsletter that will be widely disseminated through different channels (website, social media, mailing list…).

The newsletter is attached to this report and also accessible through this link: https://mailchi.mp/21e8e230c35e/6ns78x3rn8
Only short sections of each articles are provided for that newsletter. The full length is provided on the news section of the official PULSE-COM website (https://www.pulsecom-h2020.eu/news/). Individual links are provided after each article to easily reach them.

In this newsletter, the following points are addressed:

- Presentation of some technical advancements operated by partners;
- General news about the project.

1.2. Brief description of the state of the art and the innovation breakthroughs

N/A

1.3. Corrective action (if relevant)

N/A

1.4. IPR issues (if relevant)

N/A

Deliverable report

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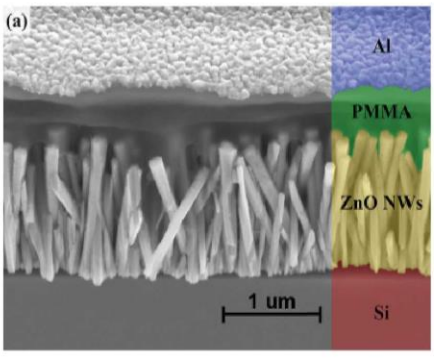
Dear PULSE-COM follower,

It's been now 16 months that the PULSE-COM project has been launched. A lot of challenges have been faced and not only on the technical side. As everyone, people working on the project have been directly impacted by the multiple lockdowns imposed by the Covid-19 pandemic. However, we are proud to have been able to produce within this troubled time some significant progress on our project.

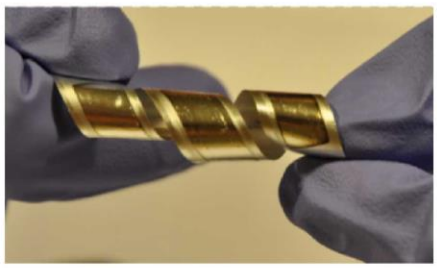
Before letting you discover some of our progresses, let us just recall the goal and approach of PULSE-COM project. It aims at realizing a radical new class of photo-activated devices changing the current paradigms in the frame of a new area of investigation such as photo-activated piezoelectricity. It will explore and enhance properties of novel, cost-effective photo-mobile polymer (PMP) films combined with modern lead-free piezoelectric (PZL) to produce new composite materials predestined for a wide range of applications never before considered.

We hope that the following news from all PULSE-COM partners will be of interest for you!

Why piezoelectric semiconductor nanowires are interesting for the PULSE-COM project?



SEM cross-section view of a ZnO based nanocomposite integrated on a rigid substrate.



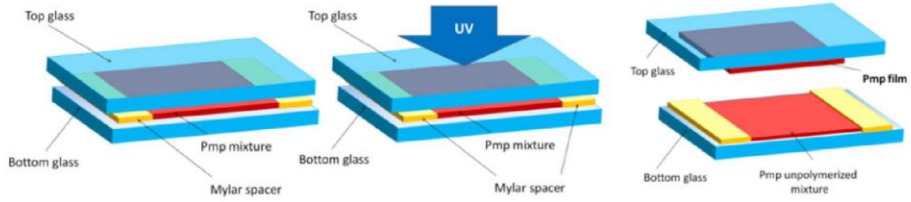
A ZnO based nanocomposite integrated on a flexible substrate.

Piezoelectric semiconducting nanowires have attracted a lot of attention recently because of their intrinsic enhanced properties compared to bulk materials. For instance, they are

more sensible to small forces, they show reduced dielectric properties and higher piezoelectric properties. All this combined could potentially increase their efficiency as transducers. They are an excellent choice for applications, such as energy harvesters, mechanical sensors, piezotronic and piezo-phototronic devices. Within PULSE-COM, UGA is developing ZnO based nanocomposites for novel photo-piezo-actuators devices and applications.

For more information, please click here

Photomobile Polymer films (PMPs) as the first brick to enter in Piezo-Phototronics

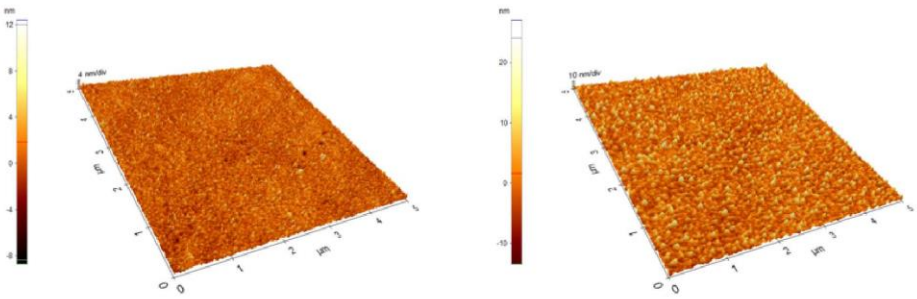


Scheme for the photopolymerization of PMP-r film and subsequent peeling-off of the film.

The use of stimuli-responsive polymeric materials is nowadays a hot topic because of their immense application possibilities. The deformations of PMP are intended to be induced and controlled by impinging light by its intensity, polarization state, wevelength. Specifically, PMP actuators change their shape or volume in response to light. We have developed two different PMP films: Interfacial tension gradient-based PMP films (PMP-r) and Azo-benzene based liquid crystals PMP films (Azo-LC-PMP).

For more information, please click here.

Ultrathin layers deposition for plasmonics



AFM images of samples of 1 (left) and 5 nm (rigth) thick Ag deposition on optical glass.

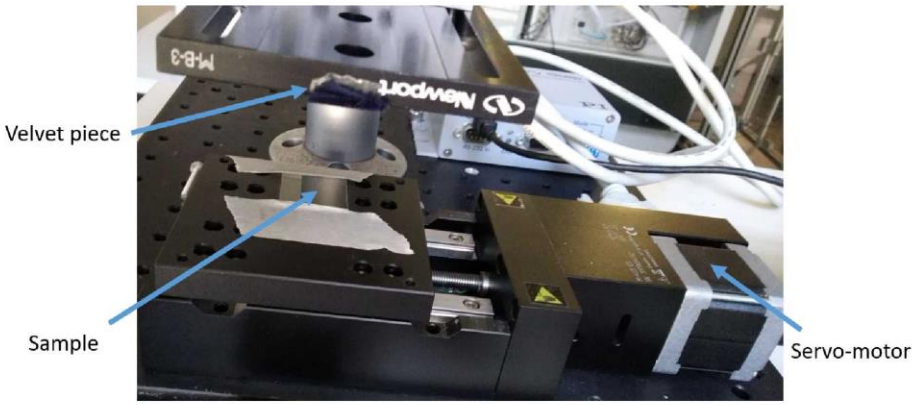
Plasmons are collective excitations of free electrons in metals, such as Au, Ag or Cu, that,

when stimulated by an energy source, such as sunlight, or a laser. A harmonic oscillation of the surface charges is induced with a wave-like behavior. In the process, they scatter light that can be read by a spectrometer, which captures and categorizes light according to its wavelength.

Silver deposition processes are very reproducible because the silver nanoparticle size distribution under identical deposition conditions is rather similar, to the benefit of potential industrial applications. Ultrathin layers deposited on PMP could select and amplify specific wavelengths in order to enhance the electrical outcome of the photo-piezo-electric systems designed in the frame of PULSE-COM project.

For more information, please clik here.

Preparation of the reaction cell of the azo-LC-PMP devices and analysis of the alignment of the LCs



ENEA system used for the rubbing processes before the contact between the slide and the velvet piece.

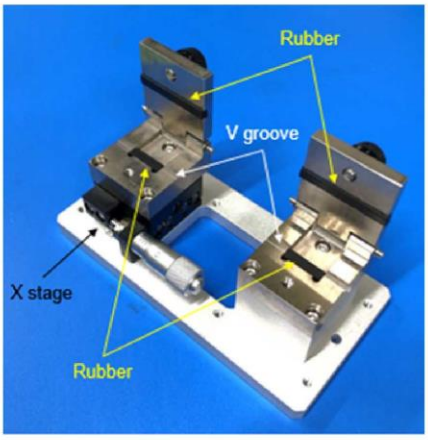
For the realization of the reaction cells a film of PVA about 10 nm was spinned and on which a directional rubbing must be carried out in order to facilitate the alignment of the liquid crystals present inside the photomobile polymers.

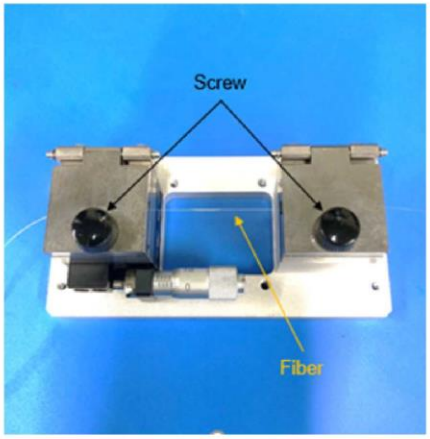
An automatic system, for the rubbing of polymeric films that have to be used in the reaction cell for the alignment of the azobenzene liquid crystal based photomobile polymers (Azo-LC-PMP) in ENEA, has been assembled.

In addition, a system for the analysis of the alignment of the LCs was set up with the use of two orthogonal polarizers and a rotating sample holder

For more information, please click here.

Design and development of different devices to be introduced in a reconfigurable optical network



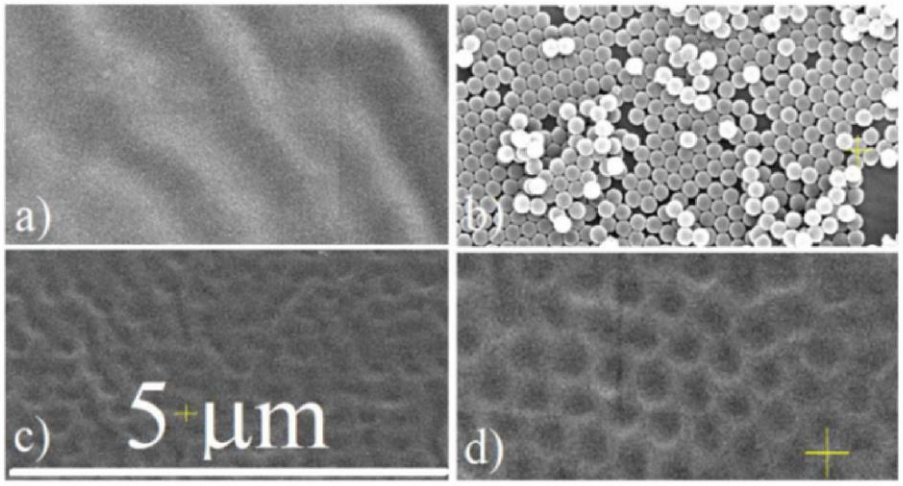


Fixing tools for D-Shape slits OF under investigation on the optic table with X-axis alignment capabilities.

SITEX 45 has developped different devices to be introduced in a reconfigurable optical network: an optical fiber fixing device, a laser diode power supply and a photodetector. These devices are of great interest for the wavelength selector system experimental set-up considered to be developed within the project.

For more information, please clik here.

Opal-inverse opal imprinted on PMP



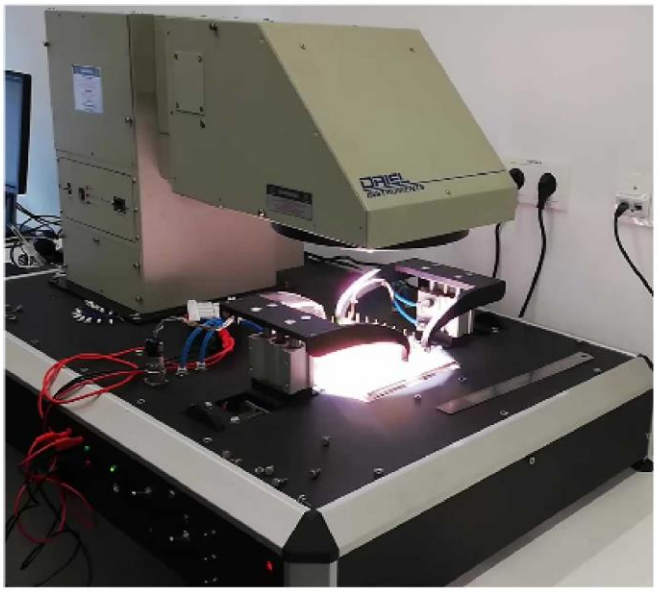
SEM images of: a) PMP polymer film surface; b) PS nanosphere monolayer onto the PMP polymer film; c) circular holes produces by PS nanosphere embossing of the PMP film; d) regular array of holes onto the polymer film which can induce Bragg reflection of the light.

INFLPR worked on a method for improving the PMP properties by using the opal-inverse opal imprinting on PMP surface.
The inverse opals are ordered porous solids, a sort of photonic crystals much cheaper and

with large number of layers. The main characteristic of photonic crystals is the existence of the photonic band gap (PBG) which makes visible light or IR strongly reflected. The existence of the PBG induce a wide range of applications such as sensors, waveguides, fiber and optical integrated circuits, and many others.

For more information, please click here.

Solar simulator

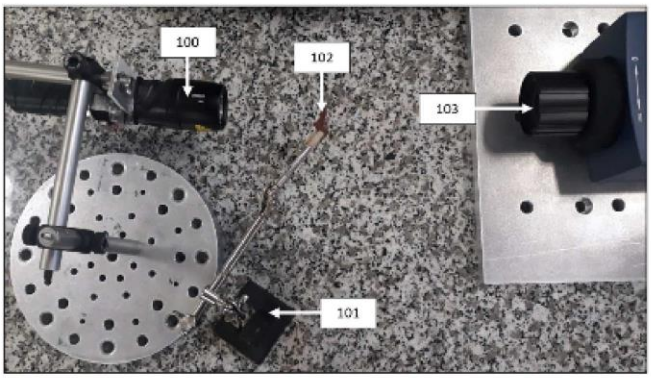


Sun simulator modified by CBRTP.

Over the course of the PULSE-COM project, prototypes of different devices based on the photo-piezo layered system are being created. In order to perform characterization and benchmarks, several test benches are being developed. One of them is the solar simulator operated in CBRTP. This device produces white illumination commonly used to mimic sunlight with the correct spectral composition and intensity.
The test bench, created with solar cell testing in mind, is being adapted to allow for testing of the novel photo-piezo system. The photoactive polymer is being tested under solar irradiation to determine its mechanical properties, eg. the amount of deflection, shrinkage, as well as its stability. Of particular interest could be testing the resilience of the photo-polymer to prolonged illumination, in purpose for integration with the piezo component.

For more information, please click here.

Measurement of the Photo-Mobile Polymer (PMP) displacement vs. light exposure

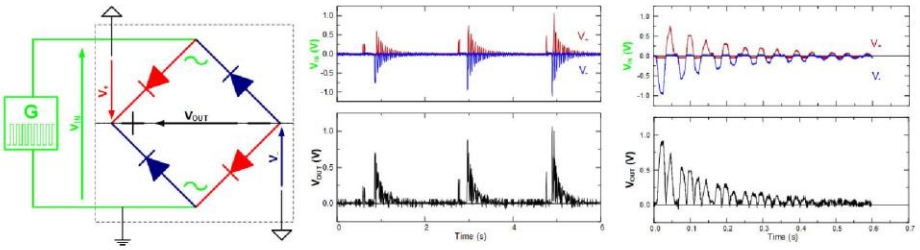


Experimental setup.

CTEC prepared an experimental setup for measuring the displacement of the Photo-Mobile Polymer (PMP), while exposed to light. The goal is to observe and quantify the displacement of the PMP in time, when it is exposed to light, and the effect of the light intensity on this displacement.
This experimental setup paves the way for a complete test bench that will be used to characterize the PMP/PZL materials in the project. In the short-term perspective, CTEC wants to use this experimental setup to confirm the possibility of driving the PMP with PWM controlled light.

For more information, please click here.

Emulator circuit for piezoelectric systems



Left to right: Schematic of rectifying circuit in Graetz-Polak configuration; Output voltage (VIN) from a piezoelectronic generator emphasizing positive (V+) and negative (V-) parts; Zoom on single excitation.

Multiple device applications based on the photo-mobile polymers are proposed in the PULSE-COM project, including an energy harvesting system. This device converts light-induced movement of the photo-mobile polymer into electrical energy via the piezoelectric effect. The system consists not only of the harvester itself but must also be integrated with the rectification and energy storage devices. CBRTP has developed a system aimed at optimization of rectification unit. It consists of an arbitrary waveform generator and a rectifying circuit. Rectification of the signal is achieved by a full-bridge diode rectifier

(*Graetz-Polak configuration*). This allows energy transfer from the piezoelectric layer to the storage unit regardless of the deformation direction, or the sign of generated voltage.

For more information, please click here.

NEWS

On February 5th, our project has been reviewed by our European Project Officer Célia Alves Rodrigues and the team composed for the occasion experts in the field: Larisa Florea, Anders Kristensen and David Mecerreyes. Paul Jonsen supplemented this board as the innovation expert. They have provided a positive feedback on our advancement and on our collaboration. We would like to thank them for their positive views on PULSE-COM EU project and their pertinent advice for future developments.

SITEX 45, as exhibitor since 2014, will once more be attending this year's edition of SENSOR+Test Fair 2021 organized in Nurnberg/Germany scheduled as a hybrid event on 4-6 May 2021.

COMMUNICATION CAMPAIGN: presentation of the PULSE-COM partners

Stay tuned to our LinkedIn page: every two weeks, one organisation that is part of the consortium will be presented with three main focus: people acting daily for the project, a general presentation of the organisation and what are their main tasks.
The first one, highlighting CNR, has been published the 12th of March 2021.

https://www.pulsecom-h2020.eu/

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