ETFE
MULTIFUNCTIONAL MODULES

A Sustainable Future for Façade Lighting

Façade lighting is an increasingly popular feature of landmark architectural projects, but the technology required can be very energy intensive. A European consortium has been researching an advanced and sustainable alternative: the ETFE Multifunctional Module.

Writer: Simon Hunkin

Illuminating Landmarks

Façade lighting is a key aspect of architectural design, and whether highlighting features of historic buildings, or integrated into panels, billboards or screens, lighting makes a lasting impression. While landmarks such as Times Square or Piccadilly Circus may come to mind first, ambitious and innovative projects have found new ways to integrate lighting with building façades.

From the Allianz Arena in Munich, to the Beijing National Aquatics Center, integrated façade lighting is becoming a mainstream feature of landmark installations, and considerations of façade lighting are made at the conception phase, requiring planning and use of innovative materials.

Textile-based Building Materials

The rise of monumental façade lighting has gone hand-in-hand with the use of textile-based building materials. Textiles made from plastics – such as Polyvinyl Chloride (PVC), Polytetrafluoroethylene (PTFE) and Ethylenetetrafluoroethylene (ETFE) – can be used to striking effect in new buildings, while also being more environmentally-friendly and sustainable than traditional building materials.

Perhaps the most promising of these is ETFE, which is a lightweight, transparent and recyclable fluorine-based plastic, weighing only 1% of an equally-sized glass panel. This 'wonder material', as it has been called, is a better heat insulator and lets in more natural light than glass, with a comparative energy saving of around 30%. It is dirt and wear resistant, can be easily repaired if torn, and can be kept clean by rain alone.

Multifunctional Building Façades

Monofunctional textiles have been used for buildings such as the O2 Arena in London (PTFE), and the Eden Project in Cornwall, UK (ETFE), but the trend in textile architecture is moving towards multifunctional materials.

When used in buildings as a two or three layered, air-filled cushion, or as a single layered cable-supported structure, ETFE can be given additional functions by integrating technologies, or can be printed on with different colors and designs for elaborate façade decoration and illumination.

One such example is the use of ETFE for Building Integrated Photovoltaics (BIPV), where photovoltaics (PV) are integrated into air-filled ETFE cushions. The cushions are supported by a lightweight aluminium frame, and have a middle layer with PV, wiring and electronics. PV systems are very reliable producers of electricity and require minimum maintenance with a proven life-span of 20-30 years. This makes them suitable for use in buildings where parts are expected to have a long life and not require frequent repair.

Top: The Allianz Arena in Munich is a well-known example of ETFE façade lighting.
Source: Greenovate! Europe

Middle: The ETFE Multifunctional Module is being demonstrated on the ITMA Materials Technology building in Avilés, Spain.
Source: ITMA Materials Technology

Bottom: Roof of the AWM Carport in Munich, comprised of ETFE with integrated photovoltaics.
Source: Taiyo Europe

The ETFE Multifunctional Module

The ETFE-MFM project has developed an innovative solution, powered by photovoltaics, for sustainable façade lighting. The Multifunctional Module consists of ETFE architecture, PV technology, illumination devices (LEDs) and flexible integrated circuits. The Module has been designed to include external batteries for onsite energy storage, but it can also be connected to the grid.

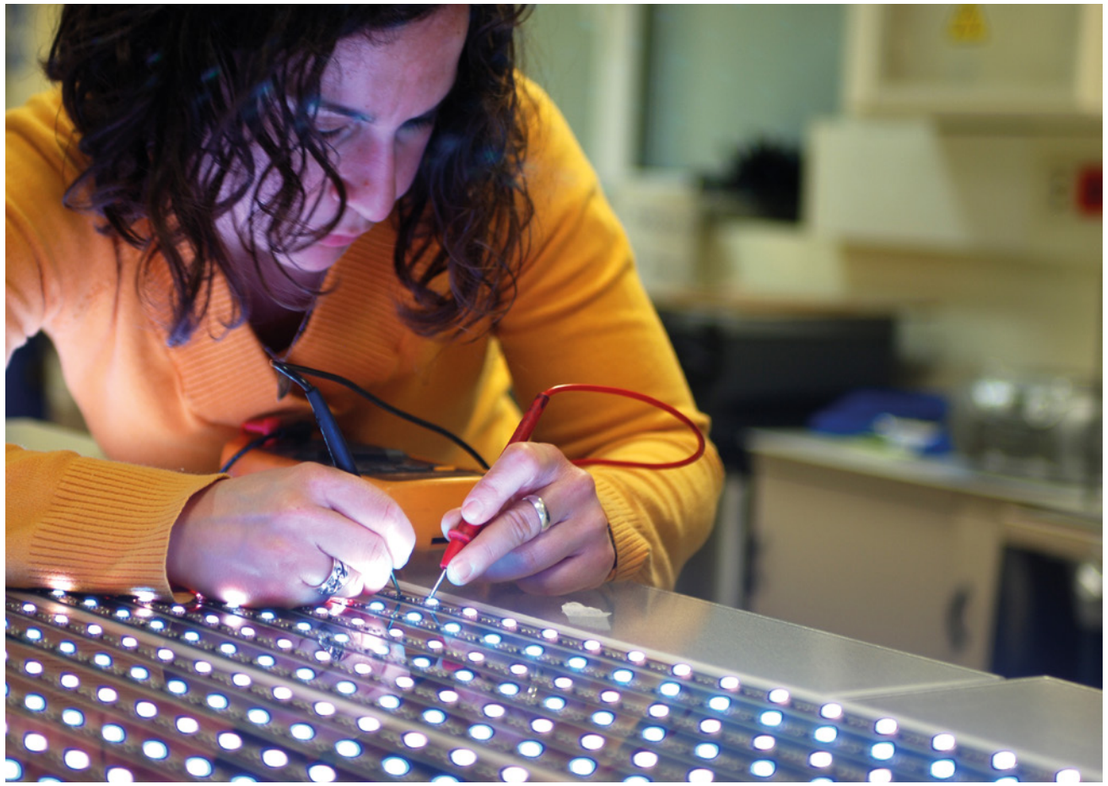
The Module can generate and store electricity from sunlight, which is then used to power impressive visual displays. Current ETFE lighting systems allow for each ETFE module to be illuminated through internal or external light projection, but there are many limitations to what can be shown. Comparatively, the ETFE Multifunctional Modules have been designed with integrated LEDs which are spaced evenly apart, acting as pixels with high enough resolution for displaying images and video.

The ETFE Multifunctional Module aspires to enhance the use of BIPV in the construction industry, providing new architectural façade lighting possibilities. It demonstrates the multiple uses of ETFE architecture, showing it as a versatile material with potentially wide application.

The ETFE Multifunctional Module attributes:

- Light-weight ETFE plastic
- PV module for electricity generation
- Illumination devices (LED) for image and pattern display
- Flexible integrated circuits for control of PV and LEDs
- External battery for electricity storage

The ETFE Multifunctional Module with integrated PV and LEDs. **Source:** ITMA Materials Technology



Demonstrating Sustainable Façade Lighting

To test and monitor the Multifunctional Module in real conditions, four demonstration units were installed at ITMA Materials Technology in Avilés, Spain. Each of the modules consists of two sheets of ETFE at front and back, with a sheet of LEDs and a sheet of organic PV modules. Two of the modules put the PVs on top, with the LEDs showing between the gaps of the PV, while the other two reverse this by using different PV designs with the LED strips on top. The aim is to find the optimal configuration for providing a clear façade image, while maximizing electricity production from photovoltaic panels.

Armando Menéndez Estrada and David Gómez Plaza — Q&A

ITMA Materials Technology

What are the main challenges for this project?

The main challenge has been integrating all the components while maintaining their individual functionalities. Requirements from architects in terms of aesthetics have also represented a significant challenge.

What are the main uses of the Multifunctional Module?

The main uses are for single buildings such as stadiums, commercial centers and pavilions, for example, but the project has also considered standardization for introducing these elements to a broader market, including through retrofitting.

What impact do you expect to see from the project's research?

Our research will add value to textile architecture, incorporating photovoltaic properties and a radically new lighting concept to the structural material, opening a new market for their use as BIPV. The product will have impact in three emerging fields of modern architecture: BIPV, LED façade lighting and ETFE architecture.

Image: David Gómez Plaza and Armando Menéndez Estrada.
Source: ITMA Materials Technology

ETFE-MFM has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement No. 322459.

For more information on the project, you can visit the website at **www.etfe-mfm.eu**