Fraunhofer FEP

PRESS RELEASE

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Retrofittable electrochromic films for windows and glass facades control light incidence

Controlling light and heat radiation through windows and glass facades at the push of a button, saving energy and still maintaining a clear view? Switchable electrochromic films that turn dark but remain transparent are expected to make this possible in the future. The fact that this can also be retrofitted in existing buildings is to be demonstrated by the joint project "EnOB: FLEX-G 4.0 - Technologies for innovative switchable films as a retrofit solution for energy-saving windows and glass facades" (funding reference: 03EN1048), which is funded by the German Federal Ministry of Economic Affairs and Climate Action BMWK. Coordinated by the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP, the project will work with six other partners to advance the state of the art to the prototype stage over the next four years. In doing so, the project aims to kill two birds with one stone - on the one hand, the windows of a Dresden school are to be retrofitted, and on the other, the pupils are to be actively involved in the technology development as a contribution to promoting career orientation.

In summer, many air conditioning systems consume enormous amounts of electricity to cool down rooms heated by the sun through its glass facades and windows. On the other hand, in winter the heat should ideally enter the room and remain there. So how nice would it be to apply switchable films to windows and glass facades that allow or block heat into the building as needed? Switching the heat flow would be a perfect solution.

The new FLEX-G 4.0 project aims to develop a cost-effective retrofit solution with innovative switchable films which can be applied to existing glass surfaces as simple as possible. In the previous FLEX-G project, crucial technological fundamentals have already been investigated, culminated in electrochromic films on a laboratory scale. These films are now to be further developed for industrial production.

"The switchable films can significantly reduce the overall energy transmittance of windows, the so-called Solar Heat Gain Coefficient, and thus the energy demand of the building", explains Dr. Cindy Steiner, project coordinator at Fraunhofer FEP. "We are strongly interested in demonstrating the results of the project in a real environment and involving young people for this purpose - pupils from a Dresden school who will also benefit from the project in their lessons!"

Federal Ministry for Economic Affairs and Climate Action

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The main objective of the project is transfer of research results into suitable system designs and manufacturing technologies for large-area electrochromic films to be installed directly on the construction site. Furthermore, robust processes for "easy" on-site application of these films to windows and facades in existing buildings are to be developed.

For demonstrating and monitoring purposes, it is planned to integrate the retrofit films at an existing building, the 46th Dresden Secondary School, as well as in the newly constructed laboratory building of Fraunhofer FEP. In addition, the Fraunhofer Institutes FEP and ISC will provide teaching materials for science subjects and offer internships for pupils. Involvement in the measurements and evaluation of the results together with the pupils is also planned. This is intended to arouse the interest of the next generation in various technical and scientific professions and also in energy-saving, sustainable technologies and their development.

Upscaling and optimizing electrochromic films from laboratory to industrial scale

To optimize and enhance electrochromic films and, in particular, to create a retrofit solution, the project partner tesa SE, Fraunhofer ISC and Coatema are working on the lamination processes required and will optimize the electrochromic cell by using suitable materials. Specifically, materials and roll-to-roll (R2R) application processes for a polymer electrolyte are being researched. Its purpose is to adhere two films of the electrochromic cell to each other like an adhesive being ion-conductive and electrically insulating at the same time, which is crucial for the switching process. For the application of the electrochromic film to window glass, a laminating adhesive with a long lifetime is also being developed. A robust application process suitable for construction sites will complete the project.

Fraunhofer FEP and ISC contribute their extensive know-how and equipment technology for R2R processes for applying the electrochromic layers and the protective layers to the films. The R2R processes are based on both vacuum thin-film processes and coatings under atmospheric pressure. Further integral part of the project is development of characterization techniques for the electrochromic films, its quality and related process control of the manufacturing technologies. The project partner Coatema is taking care of specific plant engineering issues for transferring the processes to industrial production.

In order to be able to switch the optical properties of the films at the end, solutions are being developed for grid-independent energy supply, e.g. via solar cells. For this matter, the project partner Enerthing is working on IoT systems (IoT = Internet of Things), the design of the energy supply, sensor technologies for wireless and automated control of the switching state and the integration of the sensor technology into the existing building management system. The aim of this system is to optimize energy savings.

Implementation of the results on site at a Dresden school and at Fraunhofer FEP

The finished retrofit films will first be applied to the two buildings in Dresden to determine the actual energy-saving potential. For this purpose, close coordination is taking place between the developers of the consortium, the state capital Dresden and the school in order to implement the integration of the electrochromic film, as well as the unification of this with the IoT systems later.

In advance, the Hochschule für Technik Stuttgart calculates what is theoretically possible in terms of energy savings using building modeling. The results are compared with the properties of the retrofit films produced for the school windows and the results of laboratory measurements to identify potential improvements. The studies are supplemented by life cycle analyses and cost calculation over entire product life time.

Over a period of 12 months, the savings potential in terms of cooling and heating energy demand in the two demonstration buildings will be determined. At this point, the pupils will also be involved in the research work of the FLEX-G 4.0 project. The project partners' learning materials for the lessons and the offer of orientation internships additionally support the project consortium's efforts to strengthen environmental awareness and interest in new technologies among pupils of all educational backgrounds, from secondary school to university entrance qualification.

About the project „EnOB: FLEX-G 4.0“:

EnOB: FLEX-G 4.0 - Technologien für innovative schaltbare Folien als Nachrüstlösung für energiesparende Fenster und Glasfassaden
Funded by the German Ministry of Economics and Climate Action
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Project partners:
- Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP
- Fraunhofer Insitute for Silicat Research ISC
- Hochschule für Technik Stuttgart
- tesa SE
- Coatema Coating Machinery GmbH
- Enerthing GmbH
- Landeshauptstadt Dresden

Fraunhofer FEP scientists will also be available with further information for discussions during the BAU 2023 trade fair, April 17 - 22, 2023, at the Fraunhofer joint booth in hall C2 booth no. 528.

Further Publications on the topic

Thin film technologies for the energy turnaround
Galvanotechnik, 2023; Fahland, Matthias; Steiner, Cindy; Schott, Marco

Thin-film technologies for the energy transition
Press Release 07/2022; Steiner, Cindy

Switch2Save: Smart glass technologies combined with intelligent switching protocols bear an important energy saving potential for buildings
Press Release 08/2020; Fahlteich, John

Fig. 1: 46th Dresden secondary school representing an existing building on which the retrofit units of the switchable films will be tested in operation
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Picture in printable resolution: www.fep.fraunhofer.de/press

Fig. 2: New building of the laboratory and technical center of Fraunhofer FEP. The retrofit solutions of the project will be integrated at its southern gangway (right)
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Picture in printable resolution: www.fep.fraunhofer.de/press

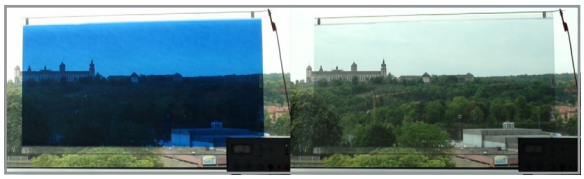

Fig. 3: Adjusting light transmission as required: electrochromic film in the dark (left) and light state (right)
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