MEM4WIN

Project Presentation

Executive Summary

MEM4WIN

ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- EC-call for “Smart Windows” in FP7-programme
- Deadline: Dec. 1st, 2011
- EC-targets:

U_g-value	< 0,3 W/m².K
Weight reduction:	- 50%
Cost reduction:	- 15%
Add. functions:	Energy harvesting, light guidance, illumination, noise reduction, LCA

- Project title: “Ultra thin glass membranes for advanced, adjustable and affordable quadruple glazing windows for zero-energy buildings”

PROJECT ID : NMP3-SL-2012-314578

LiSEC

Executive Summary

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ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- 24 Proposals submitted
- 4 Proposals selected for funding

- Total budget: € 6.620.000.-
- EC funding: € 3.998.535.-
- Project start date: Oct. 1st, 2012
- Project end date: Mar. 31st, 2016
- Duration: 42 months

Project Partners

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ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- LiSEC: Strategic project coordination, new IG-unit, thin glass, glass-glass lamination
- Profactor: Operative coordination, graphene, OPV printing
- Belectric OPV: Integrated organic PV
- Energy Glas: Integrated solar-thermal collector
- Durst: Inkjet printer for OPV and graphene ink
- Tiger Coating: upscaling of OPV ink and graphite ink
- Aixtron: CVD Graphene growth equipment

- Universities: CNR, IT | Univ. Linz, AT | Univ. Kassel, DE
  Univ. Cambridge, UK | Korea Univ., RK

Overall Project Objective

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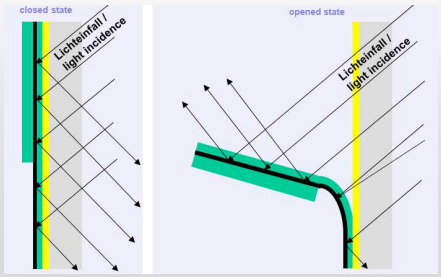
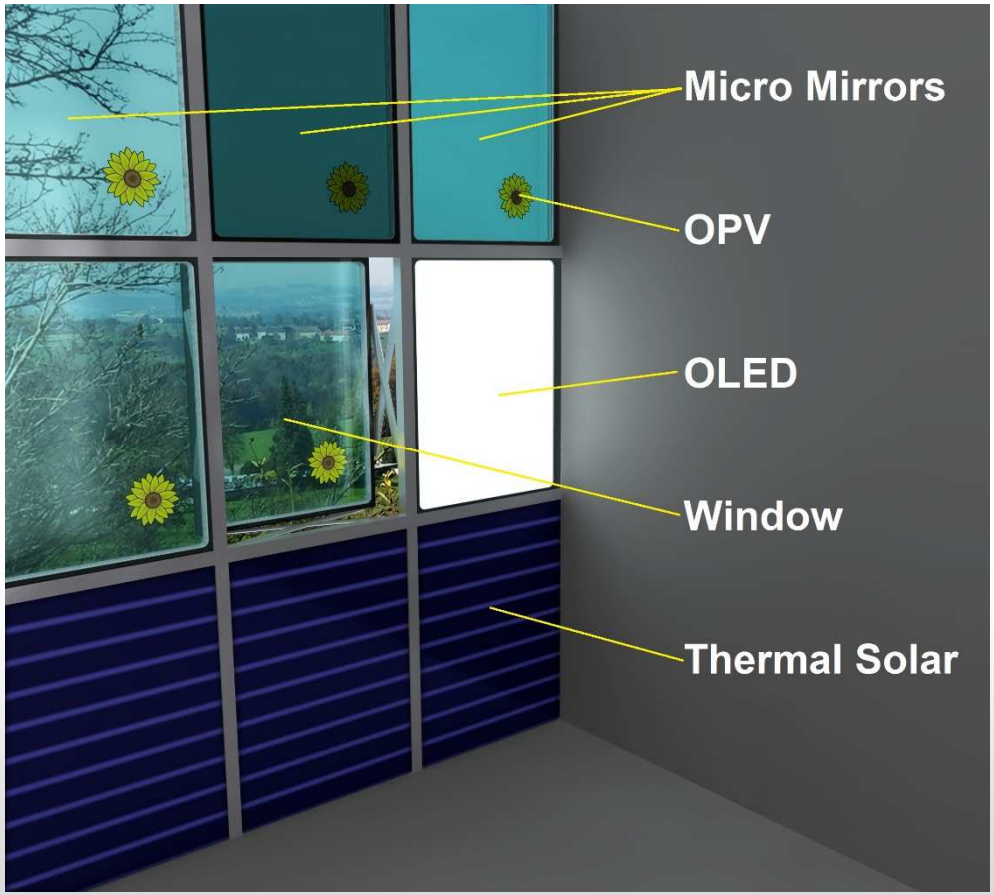
ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- Intelligent shading and light control
- Power generation (electrical, thermal)
- Integrating lighting
- Reducing weight and costs
- Appearance ("frameless sash")
- Lowering the U value further (down to 0.3 W/m²K)



Job profile
Micro Mirrors



PROJECT ID : NMP3-SL-2012-314578

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Results and Impact

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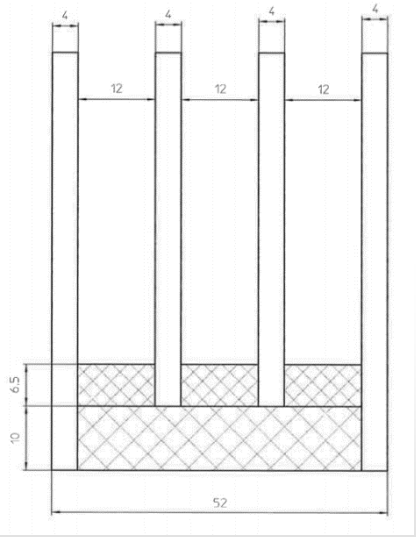
ADVANCED TECHNOLOGIES FOR SMART WINDOWS

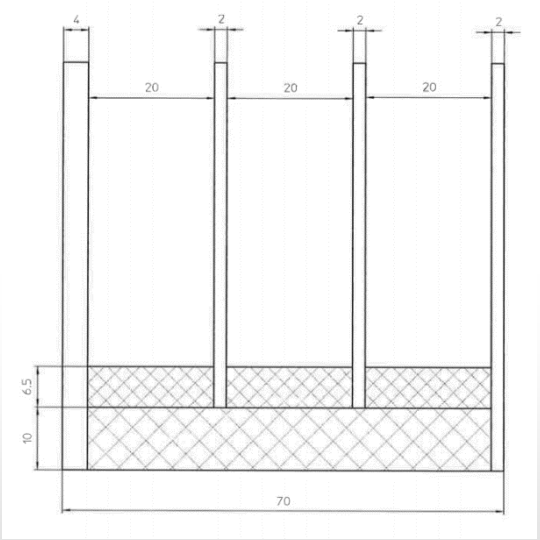
Old Design

4x12x4x12x4x12x4



New Smart Design

4x20x2x20x2x20x2



<u>With a Smart Design you get:</u>

- U-Value of 0,3 W/m²K
- Transmission higher than Triple Glass
- High Durability
  (because of low Isochore Preasure)
- Low Weight (less than Triple Glass)
- Low Carbon Footprint
  (because of Top Performance of product and Low Energy Consumption in Production)
- Higher Optical Quality of the façade
  (Excellent façade appearance)

➔ **weight reduction: up to 50%**

➔ **cost reduction: up to 20%**

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Results and Impact

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ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- quadruple insulated glass unit (LiSEC)
  - quadruple design
  - tempered ultra-thin glass (~ 0,9mm)
  - misc. machinery (prototypes)

→ Key technologies to develop:

  - Strong thin glass
  - AR-Coating

➔ U_g < 0,3 W/m².K

➔ gas loss rate: < 0.60%/a


Nachweis

ift ROSENHEIM

LiSEC Austria GmbH
Peter-Lisec-Str. 1
3311 Sieberstetten
Österreich

Mehrscheiben-Isolierglas, gasgefüllt

Quadruple Glazing TPA

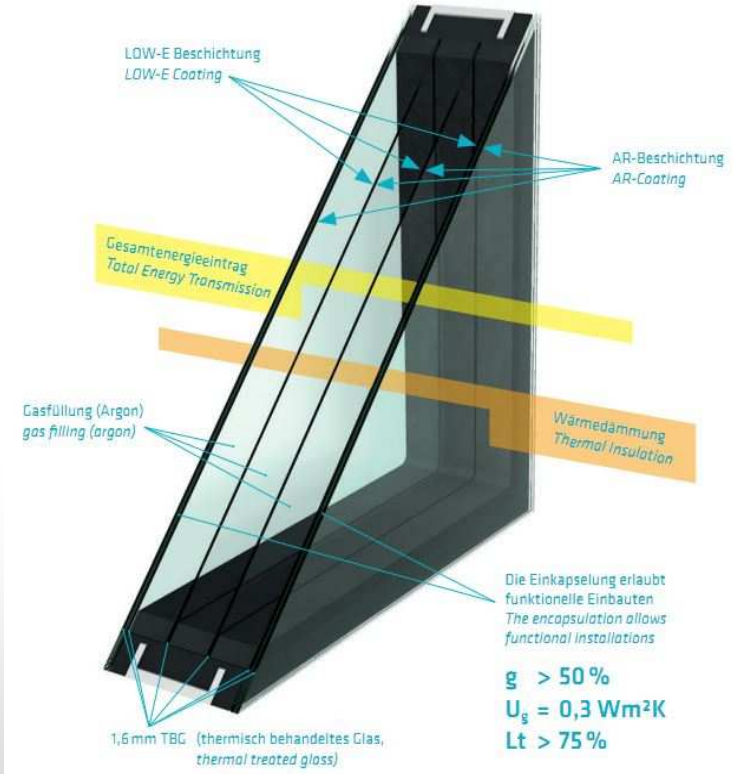
370 x 526
4 Angaben des Herstellers
3.96 / 20 / 1.8 / 20 / 1.8 / 20 / 3.96
Basis: Polyisobutylen, TPS-Abstandsrahmen, Strangpresse
8.5 mm, Fa. Könnerring

Basis Polysulfid, Hattorherm ME3-035, Fa. Könnerring
Basis Polyisobutylen, TPS-Abstandsrahmen, Strangpresse
8.5 mm, Fa. Könnerring
Mehrscheiben-Isolierverglasung mit der SZR, abgedeckt durch 1.8 mm thermisch behandeltes Glas TBG, in der Bekundschichtstoff angebettet DFH-Profilschiene

Das Mehrscheiben-Isolierglas entspricht den Anforderungen der

DIN EN 1279-3

in Rosenheim
15.10.2014



Schnittmuster der neuartigen IG-Einheit | *section of the novel IG-unit*

PROJECT ID : NMP3-SL-2012-314578

LiSEC

Results and Impact

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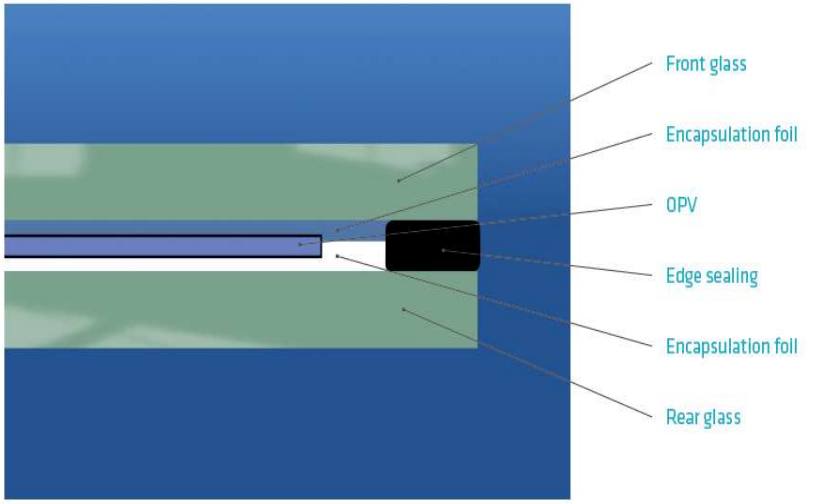
ADVANCED TECHNOLOGIES FOR SMART WINDOWS

- novel lamination technology for encapsulation of functional layers in glass-glass modules (LiSEC)
  - additional edge sealing
  - cycle time: ~ 4 min
  - max. size: 3500 x 1700 mm



➔ **water vapour diffusion tightness: < 0.01 g/m²day**

Results and Impact

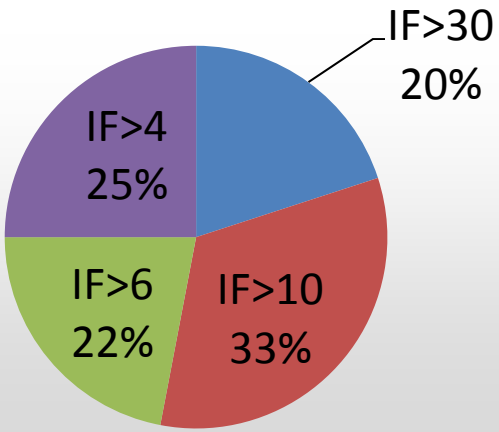
- CVD Graphene
  - doped CVD Graphene for direct transferred transparent contacts (CNR)

    sheet resistance: ~ 25 Ω/□

    transparency: ~ 90%

→ **New World Record presented @ Nanotech 2015**

Quality of Papers in MEM4WIN



→ **sheet resistance: ~ 25 Ω/□ (CNR) q**

Publicated 2015 + 2016 at:

- Scientific Reports / Nature Journals
- Journal of Nanomaterials / Hindawi
- RSC Advances / Royal Society Chemistry
- Nanoscale / Royal Society Chemistry
- . . . . .

Demonstrator – technical possible

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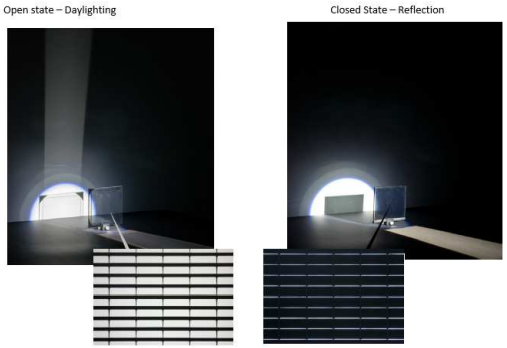
ADVANCED TECHNOLOGIES FOR SMART WINDOWS



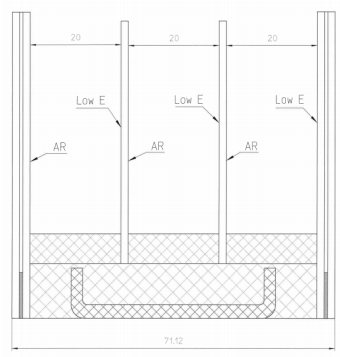
OLED

Frameless openable Window

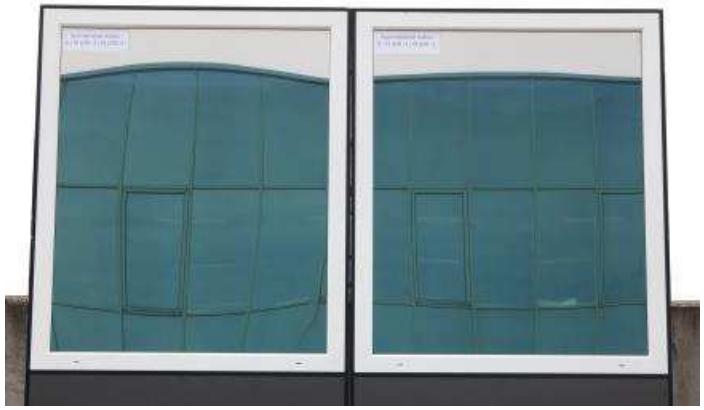
Demonstrators

Technical possible

Micro-Mirror and OPV Stele



Quadruple glass with 0,9mm glass and GFK Bar



Climate-Demonstrator

COOPERATION

LiSEC

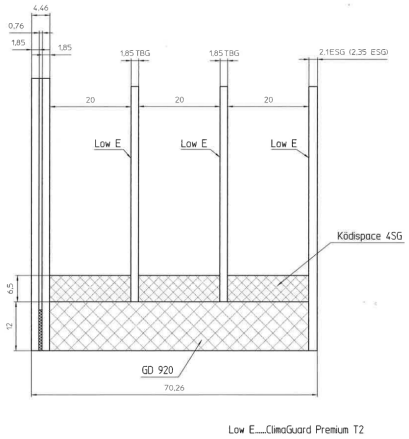
Demonstrator - sellable

ADVANCED TECHNOLOGIES FOR SMART WINDOWS

OPV

Update Façade Demonstrator

sellable



Solar Thermal Collector

- Optical Efficiency: >80%
- Functional (including piping system)

Quadruple IG-Unit

- Asymmetric
- 1,8mm Glass-Membranes
- Low-E Coating without AR
- Without GFK Bar

Results and future Impacts

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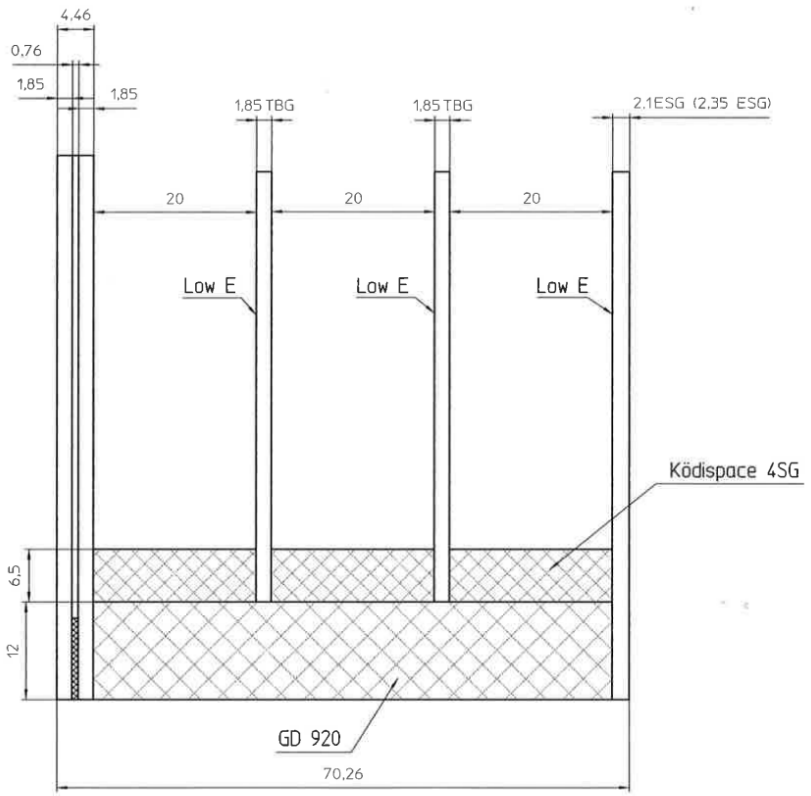
ADVANCED TECHNOLOGIES FOR SMART WINDOWS



Low E.....ClimaGuard Premium T2

Quadruple IG-Unit

- Asymmetric
- 1,8mm Glass-Membranes
- Low-E Coating without AR
- Without GFK Bar

Passed Certification:

- DIN 1279-3 Part 2 Waterthightness
- DIN 1279-3 Part 3 Gasproffness
- DIN EN 12150: >3mm chanced to >2mm glass
- . . . .

open Development / Certification:

- Frame for IG-Unit >60mm (open Frame Development)
- Frameless Window (open development of fittings)
- Façade Systems >60mm (open System Development)

COOPERATION

LiSEC

Contacts

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ADVANCED TECHNOLOGIES FOR SMART WINDOWS

Exploitable Result	Contact
tempered ultra-thin glass membranes	LiSEC, Markus Jandl markus.jandl@lisec.com
novel lamination technology (encapsulation of functional layers in glass-glass modules)	LiSEC, Markus Jandl markus.jandl@lisec.com
quadruple insulated glass unit	LiSEC, Andreas Mader andreas.mader@lisec.com
frame-less, openable window for application in facades	LiSEC, Andreas Mader andreas.mader@lisec.com
solar-thermal collector (fully integrated in IG-unit)	Energy Glas, Mirco Franke mirco.franke@energy-glas.de
doped CVD Graphene (direct transferred transparent contacts)	CNR, Giovanni Bruno giovanni.bruno@cnr.it
CVD Graphene growth equipment	Aixtron, Dr. Alex Jouvray a.jouvray@aixtron.com
LPE Graphene ink	University of Cambridge, Andrea .C. Ferrari acf26@hermes.cam.ac.uk
graphite ink	TIGER, Iurii Gnatiuk iurii.gnatiuk@tiger-coatings.com
micro mirror arrays	University of Kassel, Prof. Dr. Hartmut Hillmer hillmer@ina.uni-kassel.de
OPV glass-glass module (direct inkjet printed organic PV cells)	Belectric OPV, Tobias Sauermann tobias.sauermann@belectric.com
industrial large-format OPV inkjet printer	DURST, Eugen Maier e.maier@durst-online.at