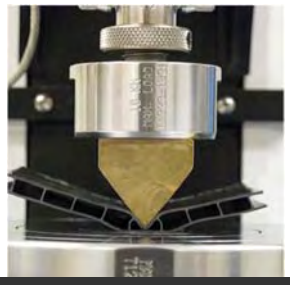
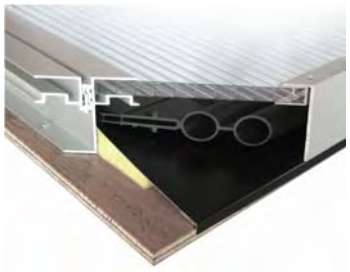





Entwicklung von Kunststoffkollektoren in Norwegen

Michaela Meir

University of Oslo, Dep. of Physics, Norway

TASK39

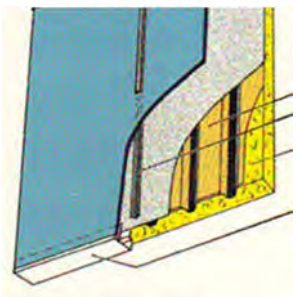
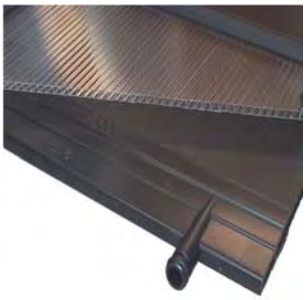
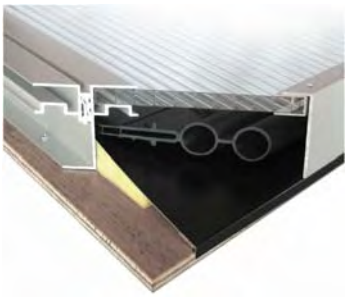
enova

The Research Council of Norway

"Kunststoff als Wachstumsmotor für die Solarthermie", JKU, Linz, 6. Juli 2011

aventa solar

... started in 1977

1977: 1st solar heated house in Norwegen

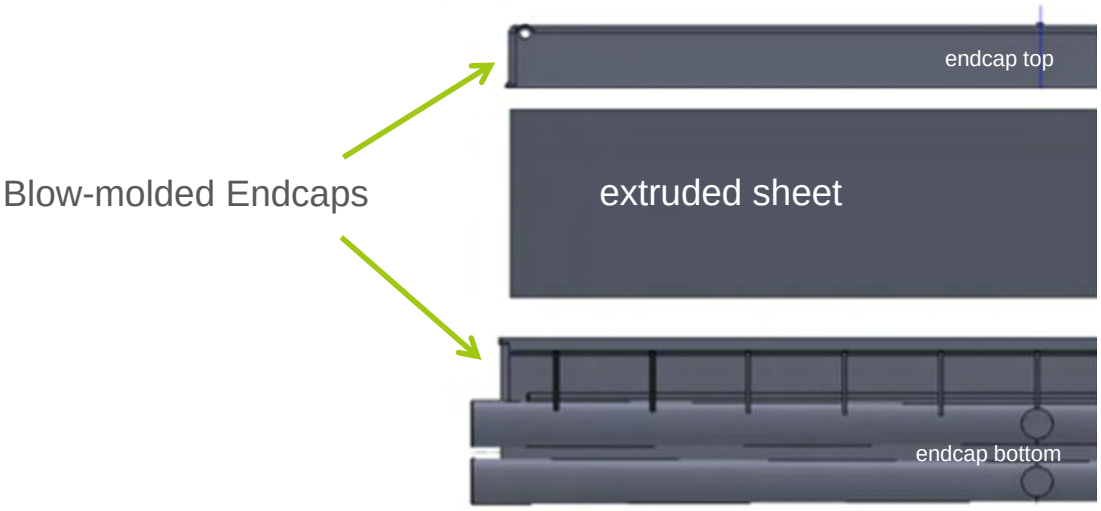
SOLNOR-Konzept: Aluminiumabsorber mit Kunststoff-abdeckung

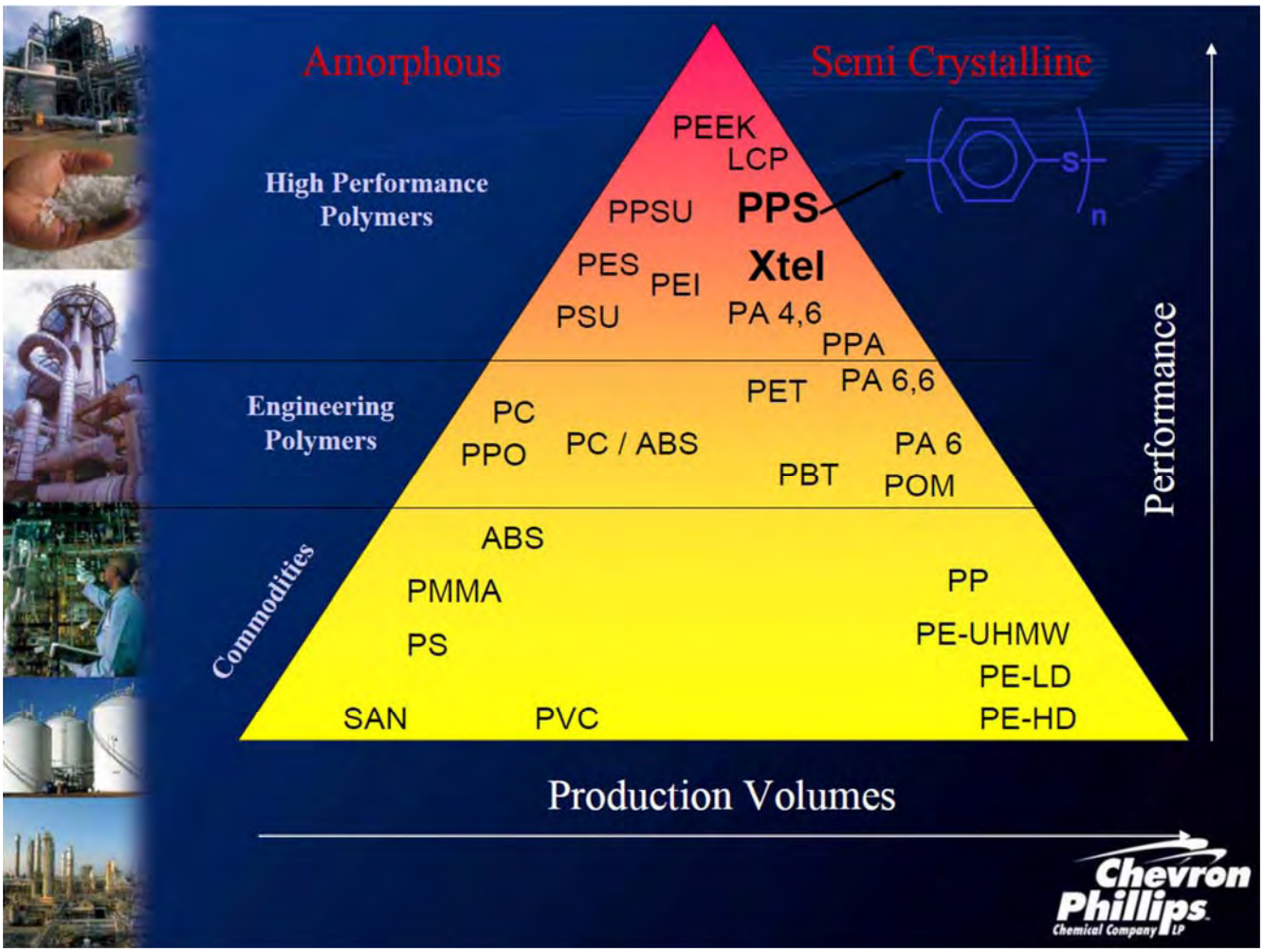
Solarnor-Konzept: NORYL-Absorber mit Kunststoff-abdeckung

AventaSolar-Kollektor: PPS-Absorber mit Kunststoff-abdeckung

All-polymeric collectors with PPS Absorber

- PPS : **Polyphenylene sulfide**, semi crystalline;
  Xtel®XE: Series of PPS/Elastomer alloys:
  Increased flexibility and ductility and enhanced impact resistance





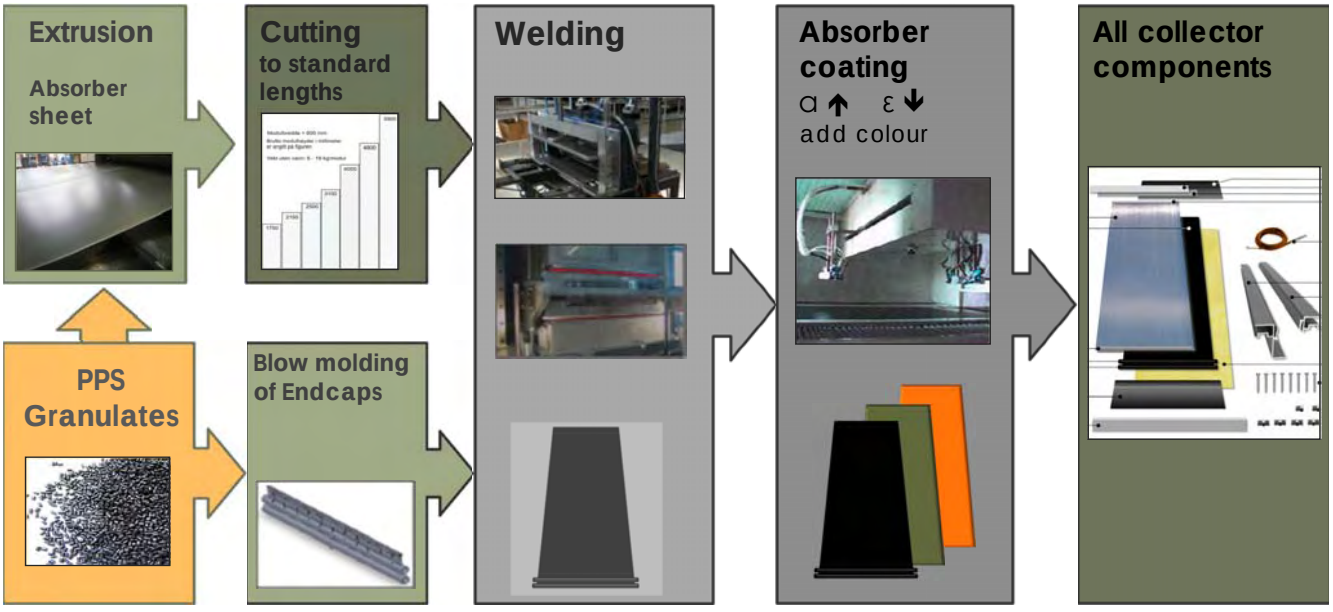
Collaboration, industrial partners

- **Chevron Philipps Chemicals International N.V (Belgium)**
  subsidiary of Chevron Phillips Chemical Company LLC with headquarters in the Woodlands, Texas.
  Producers of styrenics and aromatics a leading supplier of olefins and polyolefins, alfa olefins, specialty chemicals and proprietary plastics.

- **DS Smith Kaysersberg Plastics (France)**
  - manufacturer of plastic sheet and finished plastic products with manufacturing sites in France, Spain and the UK.

- **Aventa AS (Norway)**
  R&D of solar collectors in polymer materials together with Chevron Phillips Chemicals, Smith Group Kaysersberg Plastics and the University of Oslo.

Production steps PPS-Absorber



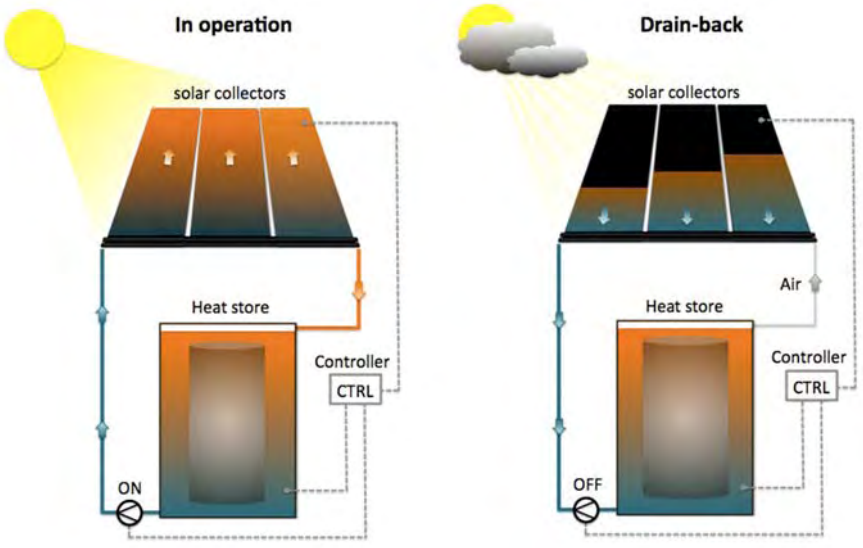
Extrusion of PPS

First worldwide sheet extrusion of PPS performed by Chevron Philipps, Kaysersberg Plastics and Aventa

Prinzip - I

Solaranlage:

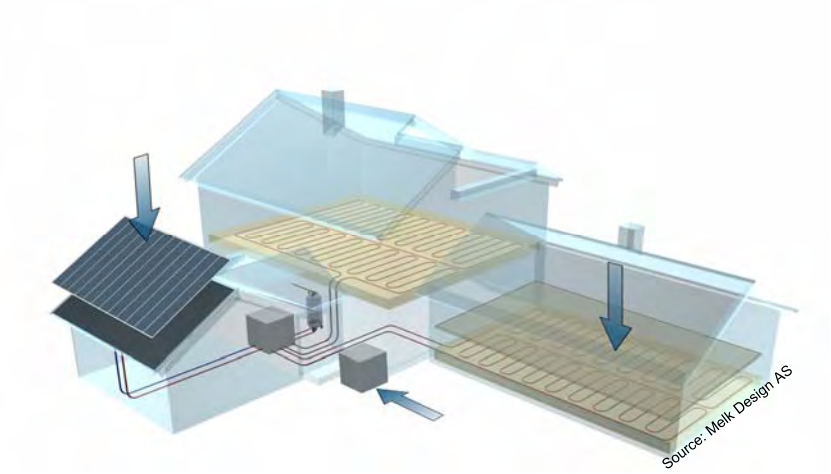
- **Drain-back**
- **Druckloser Solarkreis**
- **Wasser als Wärmeträger**
- **"Direct system" (Drain-back-Reservoir)**



Prinzip - II

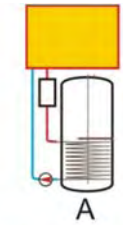
Solaranlage:

- **Niedertemperaturheizung**
- **Gebäudeintegration: Dach- oder Fassaden-integrierte Kollektoren ersetzen konventionelle Baumaterialien**
- **Arkitektur!**

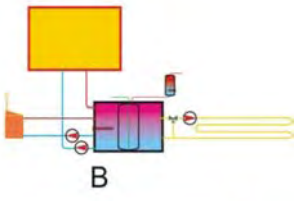


Applications, favourable systems

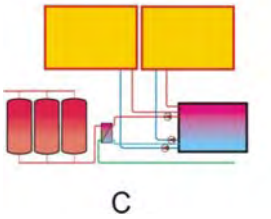
Solar Domestic Hot Water Systems
Target market: Existing residential homes



Solar Combi Systems for hot water and space heating
Target market: New residential homes



Solar Heating Systems for larger buildings
Target market: New and existing buildings



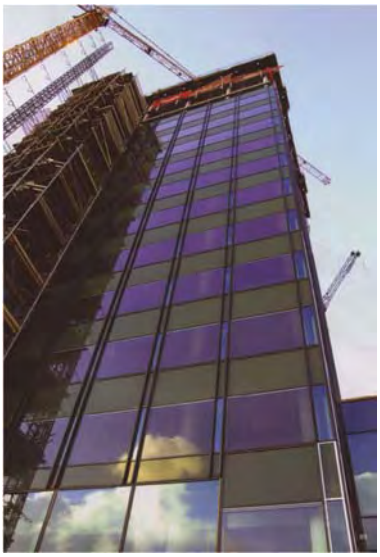
Kollaboration mit Bauindustrie

OBOS

140 000 apartments in Oslo area

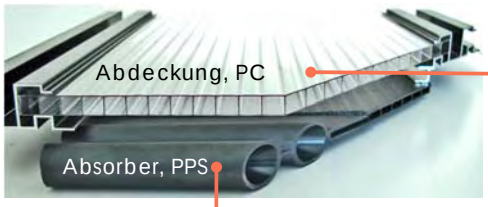
Largest Norwegian housing company OBOS invests in Aventa AS (autumn 2010).

HubroHansen AS & Aventa AS: Collaboration: Integration of absorbers in pre-fabricated glass / facade modules

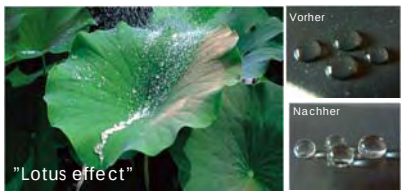


MULTIFUNCOAT
Multi-funktionelle Beschichtungen für Kunststoffkollektoren

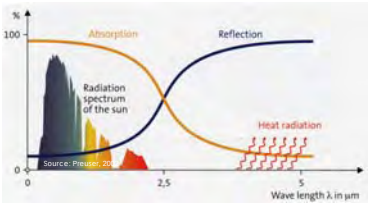
AVENTA - Kollektor



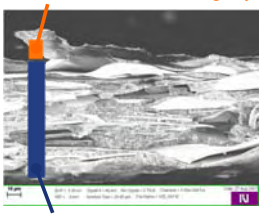
Projekt 1:
Selbstreinigende und kratzbeständige Oberflächenbeschichtungen (Kollektorabdeckung)



Projekt 2:
Thickness Insensitive Spectrally Selective paint coatings
Increase efficiency
Colours => Esthetics

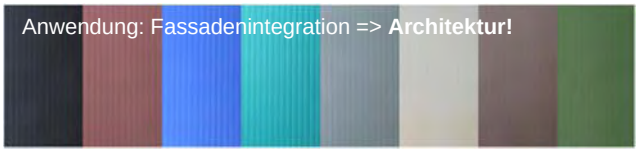


Solar radiation absorbing layer



IR reflective layer.

CONSORTIUM PARTNERS
National Institute of Chemistry, Slovenia
COLOR, HELIOS Group; Slovenia
AVENTA AS, Norway



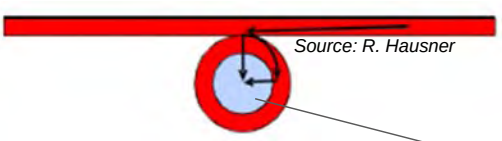
MATERA

Financial support by the **Research Council of Norway** through the BIP project No. 189710/S10 and as an European MATERA ERA-NET cooperation from 2009-2011 is kindly acknowledged.

Geringe Wärmeleitfähigkeit

Kein Nachteil bei richtigem Design!

Konventioneller Flachkollektor
F ≈ 0.93 - 0.97



— 1 mm

λ_{cop} = 384 W/(m K)
λ_{alu} = 220 W/(m K)
Volumenstrom, Wärmeträger ca. 0,3 l/(min m²)

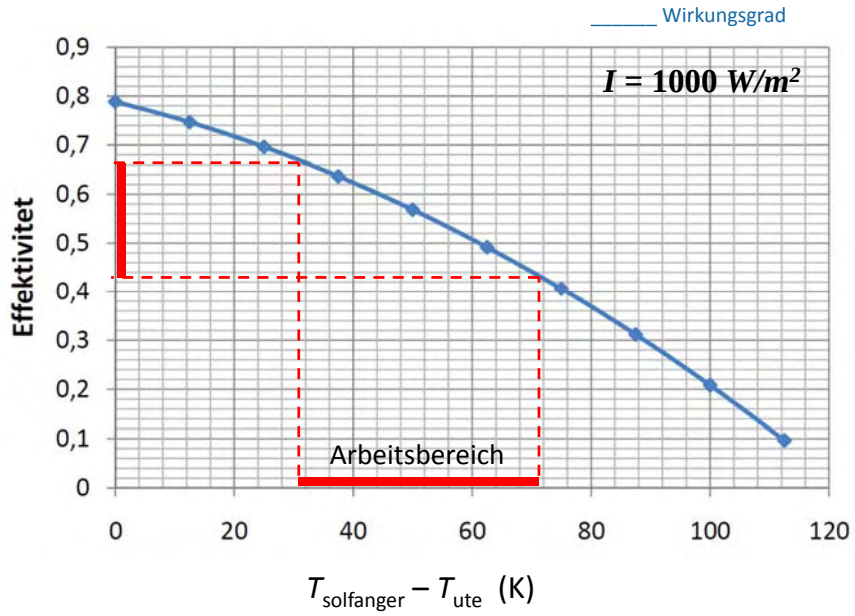
Flachkollektor aus Kunststoff
(mit Abdeckung)
Doppelstegplatte, ca. 1 mm Wandstärke

F ≈ 0.97 – 0.98

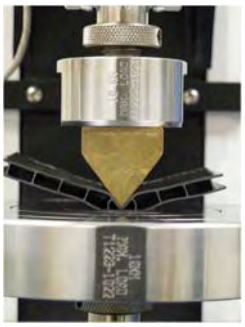
1 mm

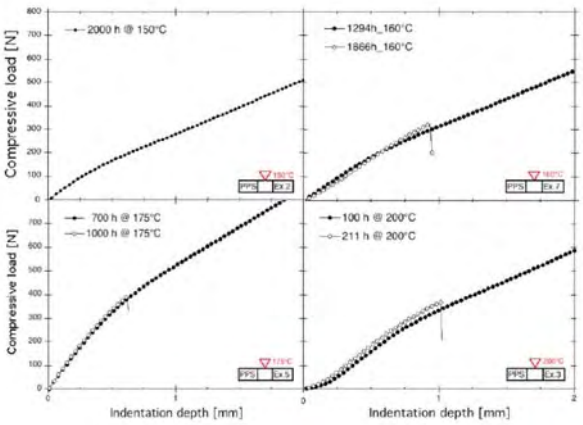
λ_K ≈ 0.2 W/(m K)
Volumenstrom, Wärmeträger ca. 1 l/(min m²)

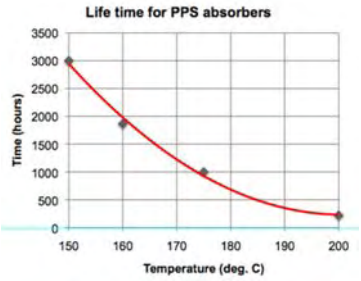
Kollektorwirkungsgrad



Service-life-estimations: Indentation tests







Assumptions: System is passive (stagnation temperature) 36 hours pr. month with clear sky.

Ambient temperature	Jan – Febr:	20 ° C
	Mar – April:	30 ° C
	May – Aug:	40 ° C
	Sept – Oct:	30 ° C
	Nov – Dec:	20 ° C

- Results, method, further reading: Service-life estimations:
  Rekstad et al., 2010. SOLAR COLLECTOR ABSORBERS IN HIGH-PERFORMANCE POLYMERIC MATERIALS, Eurosun 2010, Graz, Austria, 28.09. - 01.10.2010

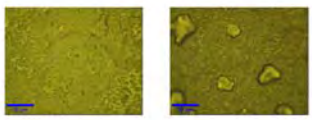
Non-destructive methods

Investigation methods, material changes / degradation

Fraunhofer ISE

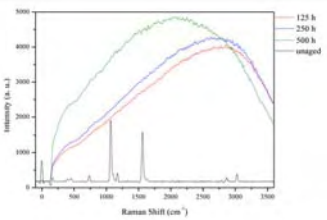
A) Ramanmikroskopische Untersuchung

Micrographs von PPS-Proben vor (oben) und nach (unten) 500 h UV Bestrahlung



Karl-Anders Weiss et al., Fraunhofer ISE Germany

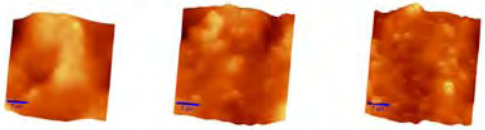
C) Raman-spectra of PPS, after different times of exposure to UV irradiation.



Karl-Anders Weiss et al., Fraunhofer ISE Germany

B) Rasterkraftmikroskopische Untersuchung

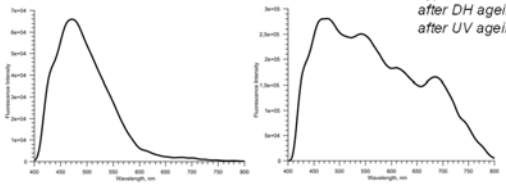
Topography von PPS-Proben vor (links), nach 500 h UV irradiation (Mitte) und 500 h bei 85 ° C, 85% r.h. (rechts).



Karl-Anders Weiss et al., Fraunhofer ISE Germany

D) Fluorescence spectroscopy for observation of polymer aging

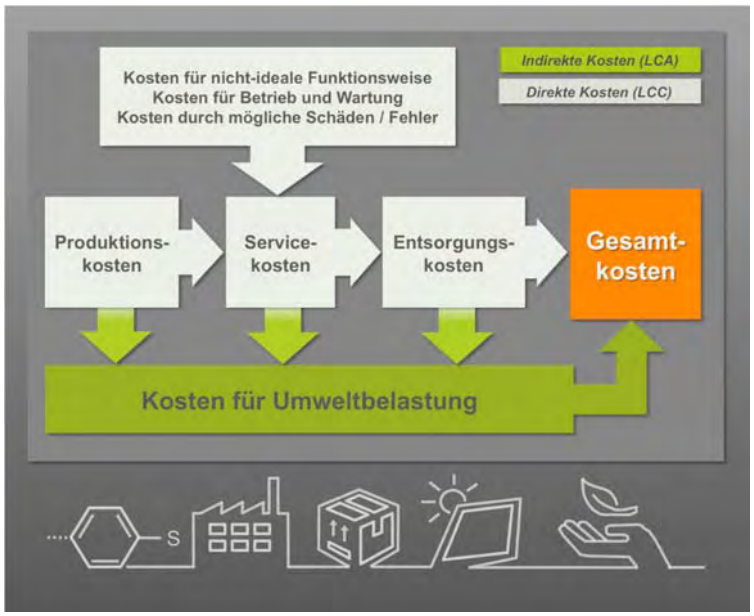
Typical fluorescence spectrum after DH ageing (left) and after UV ageing (right).



Beate Röder, Humboldt-Universität zu Berlin, Germany

Further reading: Summary of preliminary analysis in IEA-SHC Newsletters: http://www.iea-shc.org/task39/newsletter

Total cost accounting approach



Mit Hilfe eines Gesamtkosten-verfahrens soll die Wahl von Polymermaterialien beim Produktdesign im Rahmen von Subtask A (IEA-SHC Task 39) analysiert werden.

Bo Carlsson and Helena Persson
Linnæus University, Kalmar, Sweden

Aventa AS, Oslo, Norway

Further reading: Follow IEA-SHC Newsletters: http://www.iea-shc.org/task39/newsletter

Kollaboration mit Partnern in Österreich

- **PCCL : Doktorarbeit Susanne Kahlen (Prof. Dr. G. Wallner, Prof. Dr. R. Lang)**
- **AEE - Institute for Sustainable Technologies** (AEE-INTEC)
- **AIT – Austrian Institute of Technology**
- **IEA-SHC Task 39: Polymeric Materials in Solar Thermal Applications**
  Operating Agent: Dr. M. Köhl, Fraunhofer Institute for Solar Systems, Freiburg Germany;
  http://www.iea-shc.org/task39/