



efficient photonic solutions

A physicist's journey: Transitioning from academic to industrial jobs



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23 February 2016

Today's journey



OUTLINE:

- ▶ Why physics and industry?
- ▶ How to ease the transition?
- ▶ My transition and acquired skills
- ▶ Examples of physics (optics) in industry
- ▶ Overview m-u-t Group
- ▶ Gender issues

DISCLAIMER: The statements in this presentation are my own. When facts are given, I have provided a reference to the source.

Why physics and industry?

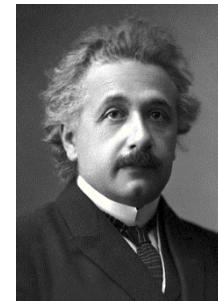


What are employers looking for?

- ▶ If you want to have someone to do math, hire a **mathematician**.
- ▶ If you want to have someone to do biology, hire a **biologist**.
- ▶ If you want to have someone to do chemistry, hire a **chemist**.
- ▶ If you want to have someone to do statistics, hire a **statistician**.
- ▶ If you want to have someone to do computer programming, hire a **computer scientist**.
- ▶ If you want to have someone to build electronics, hire an **electrician**.
- ▶ If you want to have someone to do design a machine, hire a **mechanical engineer**.

If you need someone who knows how to solve a general problem or who can perform in more than one of these fields:

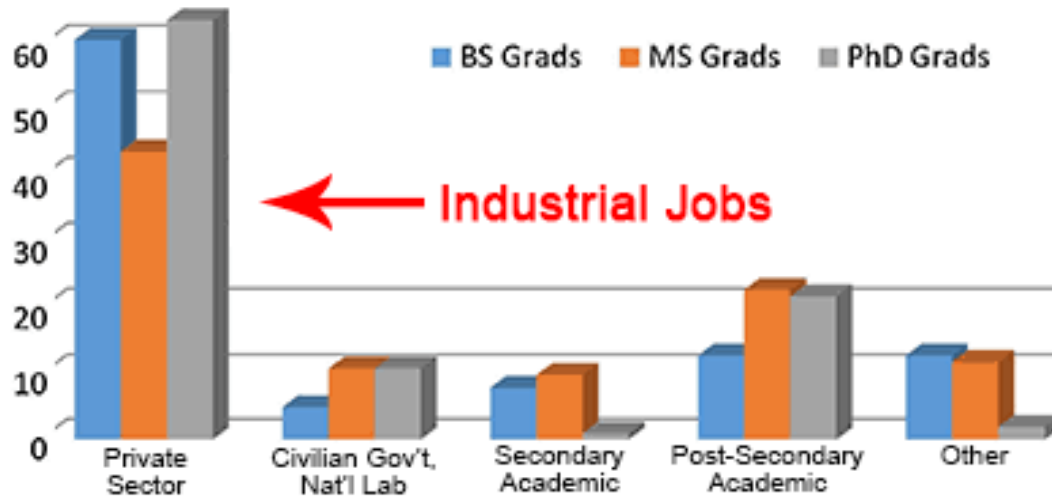
hire a PHYSICIST!



Industrial Jobs for Physicists (AIP)



Where are there jobs for physicists in general?



* Ph.D. data include on potentially permanent jobs, excluding temporary faculty and postdoc positions. Data from AIP Statistical Research Center for 2011-2012 cohorts.

- ▶ When I studied physics, this fact was in general overlooked.
- ▶ Very little organized collaboration between university and industry (very different from engineering).

Industrial Jobs for Physicists II



Where are the industrial physics jobs?

- ▶ Telecommunication
- ▶ Manufacturing
- ▶ Oil /gas extraction
- ▶ Automobile industry
- ▶ High tech: semiconductors, lasers, optics
- ▶ Medicine
- ▶ Defense industry
- ▶ Banks / Insurance firms
- ▶ Management consulting
- ▶ Energy (power distribution, solar, wind, water)
- ▶ Information



Taken from EPS economy report 2013

Foto sources: Gas, liberty voice,
WUWT, wikipedia,

Industrial Jobs for Physicists III



Benefits

- ▶ **Better** paying
- ▶ More **widely available** (even in small towns)
- ▶ Allow for **greater mobility**
- ▶ Allow for **mid-career job change** (i.e. into management)
- ▶ Many companies pay for **advanced training**
- ▶ Work with a broad range of employees (engineers of all types, accountants, MBAs, other scientists, etc.)
- ▶ Can fulfill **altruistic goals**, e.g. contributing to green technologies or public health
- ▶ When you are an expert in some field, you are needed even when you advance in age.
- ▶ **KNOWLEDGE = \$\$\$**

How to transition?



During physics studies:

- ▶ Intern at a company
- ▶ Visit job fairs / career workshops to learn where jobs are and what interests you
- ▶ Minor in a field that also interests you (e.g. business or computer science)
- ▶ Get a PhD A bachelor's degree especially in the US is not enough for physics career (other than a technician), but a masters might be.

Looking for a job:

- ▶ Find companies with products that are based on your own research and tune your resume to reflect this link
- ▶ Network with former students who found a job in industry
- ▶ Be open to new ideas and be persistent

Transitioning to Industry: My Journey



Nancy's career

Universities (1984 – 2000)

- BS, MS, PhD (Superconductivity),
- 3x Postdoc Fellowships, Assistant Professor (optics, fs-lasers, THz spectroscopy, surface plasmons)

Large global company (2000-2005)

- R&D in Telecommunications (lasers in fibers, polarization multiplexing)
- System Engineering (system design authority for telecom product)

Startup company (2006-2009)

- Managing Director (management for mass spectrometry product)

Small optics company (2010-2013)

- Managing Director (management for optical measurement systems)

Medium sized optics company (2014 – present)

- Key Account Manager (sales for a single product)

My Motto: Learning by Doing



Acquired Skills

Large global company

- R&D (*patents*, innovations for new products, papers)
- System Engineering (technical lead for product; interacted with leaders from sales, product line managers, development; lead a multinational engineering team)

Startup company

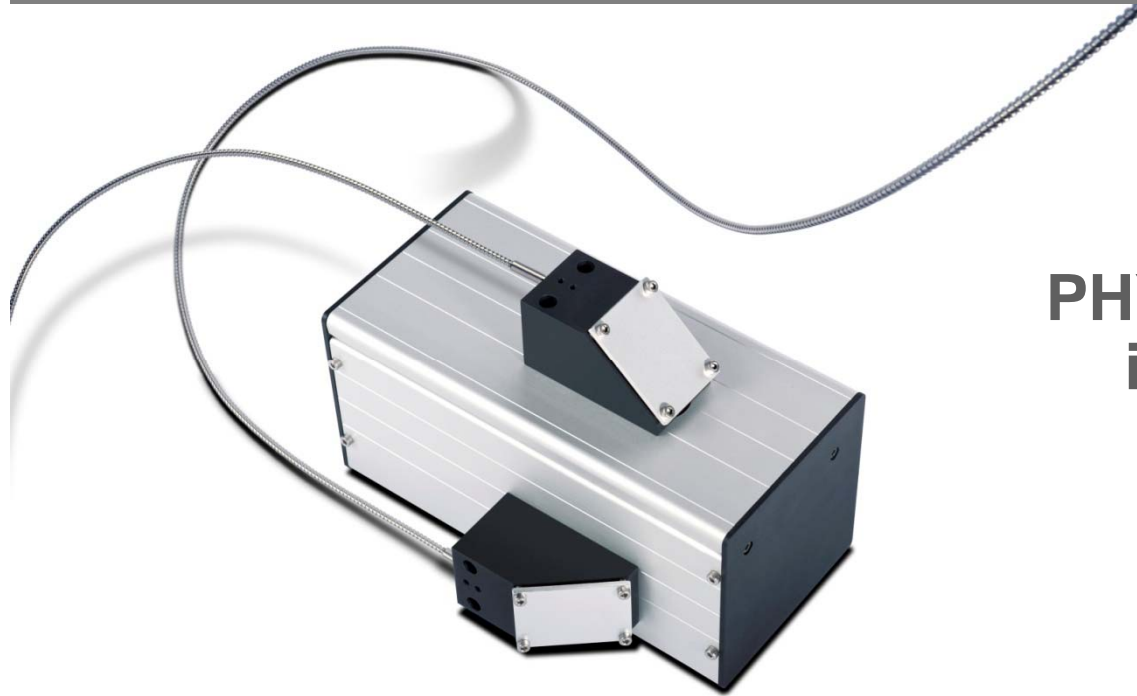
- Managing Director (project controlling, customer relations, sales and leasing negotiations, recruiting, business plan development, order process, change order management, advertising, market analysis, and reporting to company owners)

Small optics company

- Managing Director (sales / marketing, financials, company contracts, recruiting, project acquisition, project management, and reporting to company owners and banks)

Medium sized optics company

- Key Account Manager (sales for a single product, strategy)



**PHYSICS KNOWLEDGE
is still very important
for my career!**

omtsYs Thin Film Analysis (TFA) device

What can be measured with a TFA ?



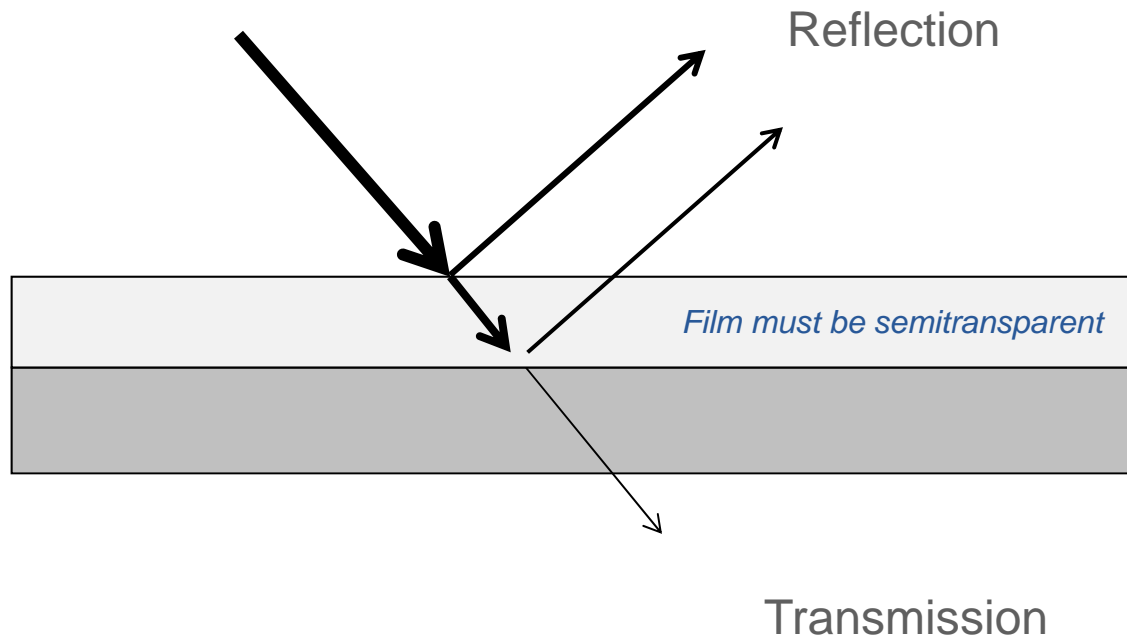
QUANTITIES:

- ▶ Reflection (R) and Transmission (T)
- ▶ Film thickness
- ▶ Sheet resistance
- ▶ Color (e.g. L a*b* values)
- ▶ Moisture content (e.g. of PVB in car windscreens)
- ▶ n/k (index of refraction) values
- ▶ Absorption

How does a TFA work?

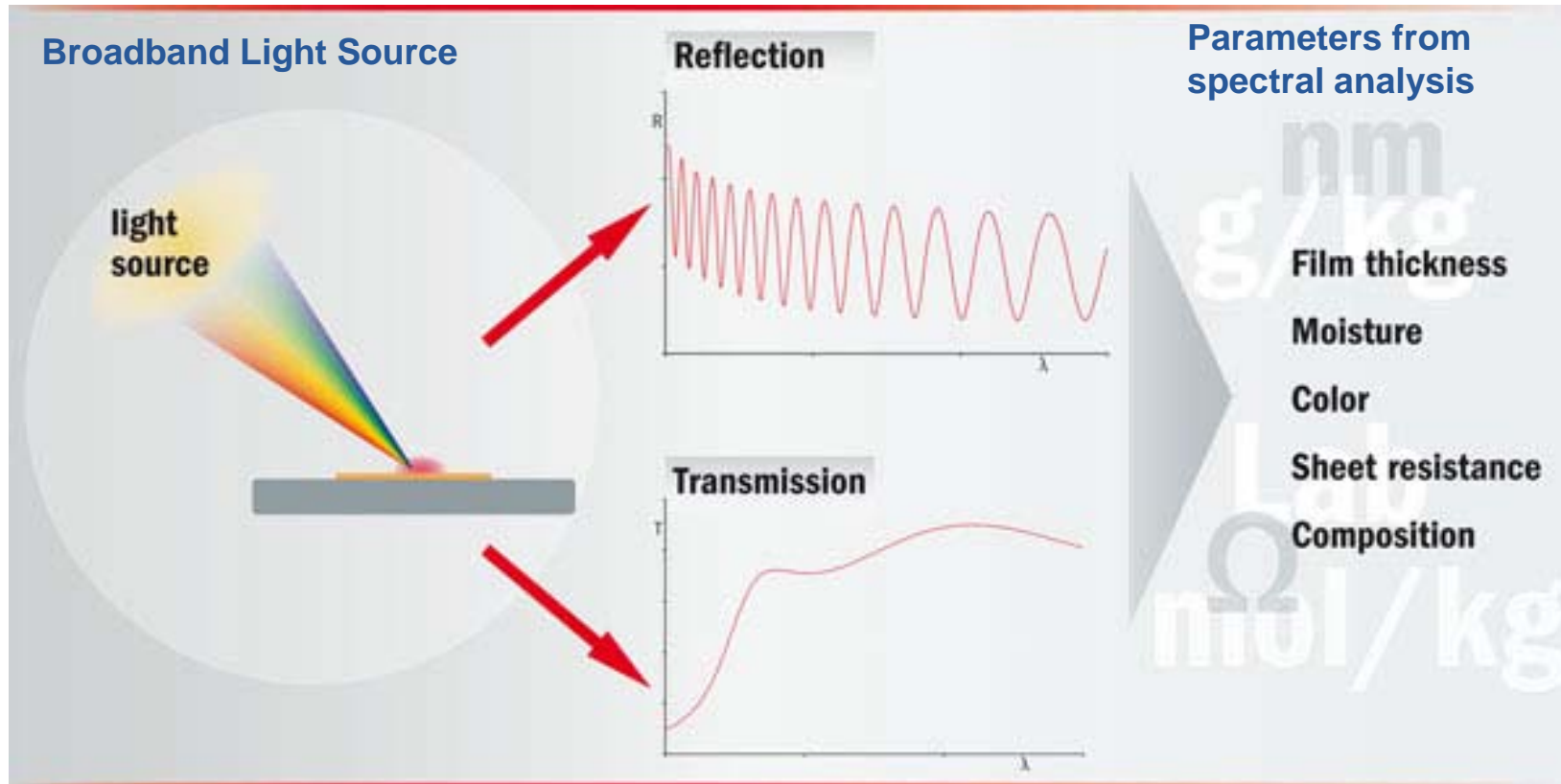


Measure **R** and **T** (which depend on material properties)



Technique often call **REFLECTOMETRY**

Reflectometry with a TFA



Simultaneous Wavelength Measurement
via diode-array spectrometers

Thin Film Analysis (TFA) device



Lab-to-line reflectometry solution

Reflection and transmission measurable over a range from **380 - 2200 nm**

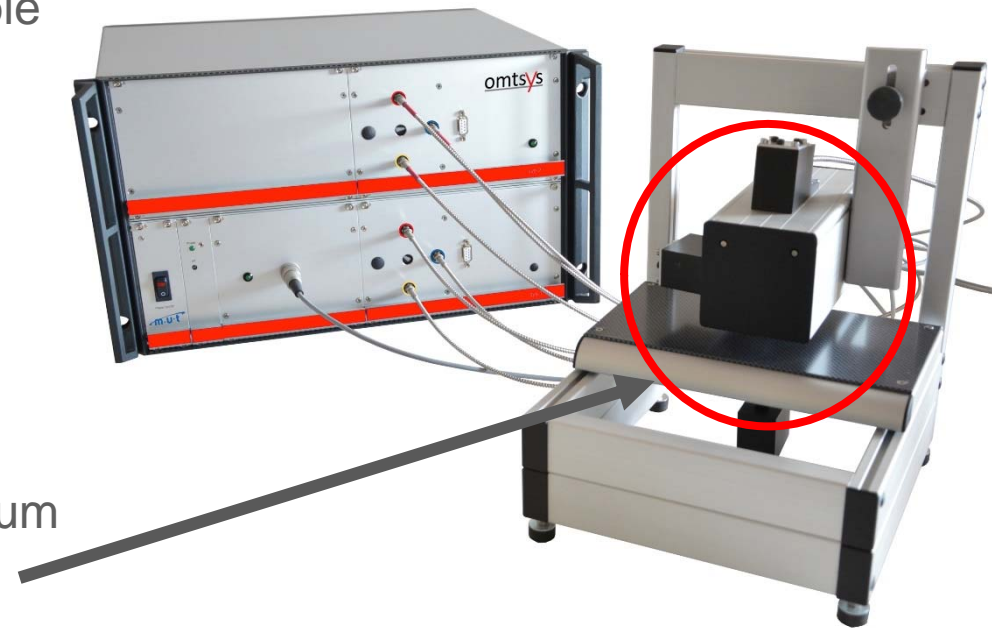
Built in halogen light source

Customized Software

for data acquisition and analysis

Measurement head designed for vacuum operation and harsh environments

Successfully incorporated in factories worldwide for thin film analysis



Laboratory device

Thin Film Analysis (TFA) device



Lab-to-line reflectometry solution

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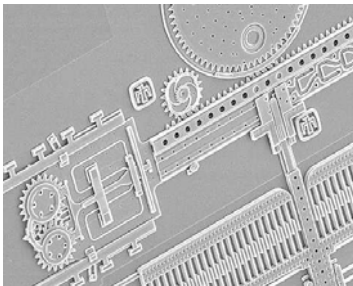
Measurement head designed for vacuum operation and harsh environments

Successfully incorporated in factories worldwide for thin film analysis



Inline device 100ms

Where can the TFA be used?

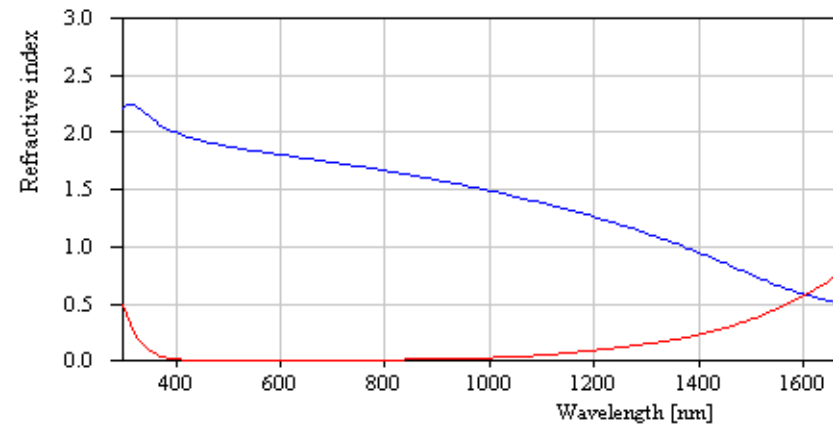
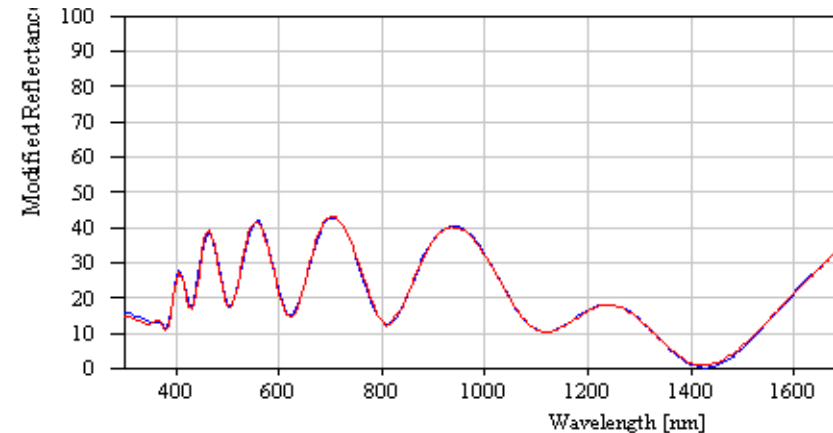
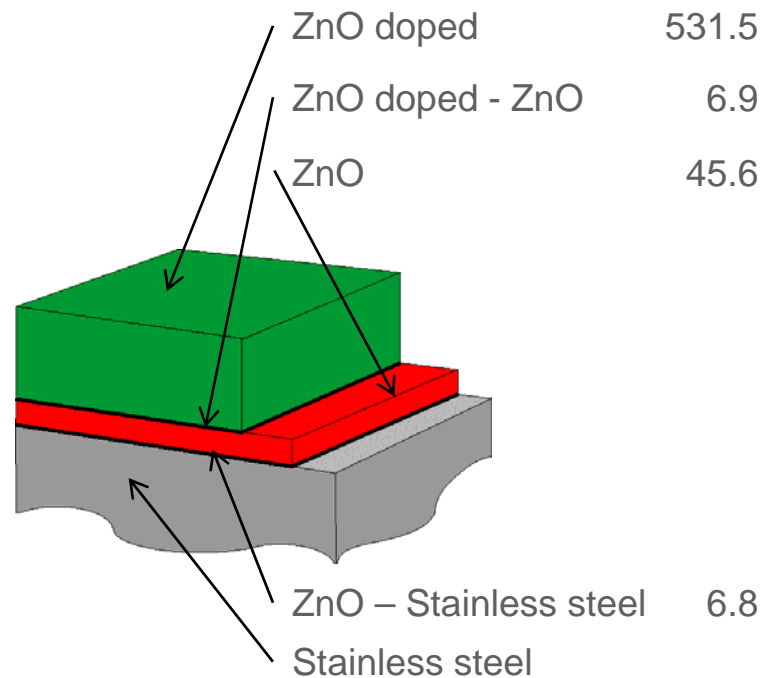


MARKETS:

- ▶ Solar PV
- ▶ Glass manufacturer
- ▶ Roll-2-Roll coaters (OPV, OLED, slot-die coatings)
- ▶ Structured glass
- ▶ Printed electronics
- ▶ Coated metals
- ▶ Coated plastics (i.e. PET)
- ▶ Ultra-thin glass
- ▶ Semiconductor
- ▶ Paper

Film Thickness

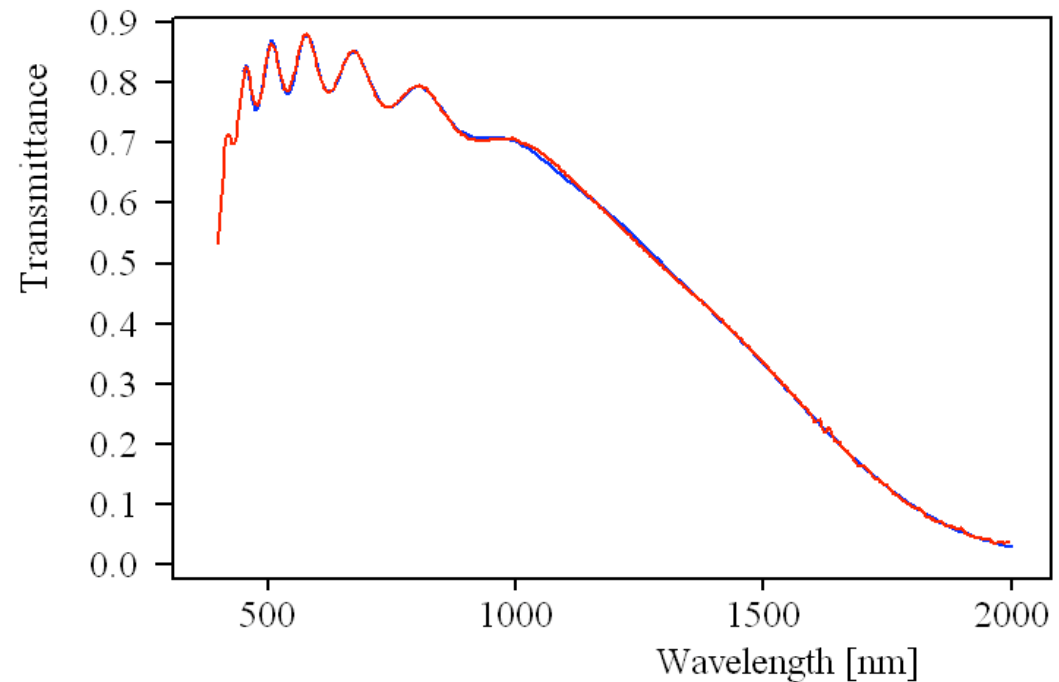
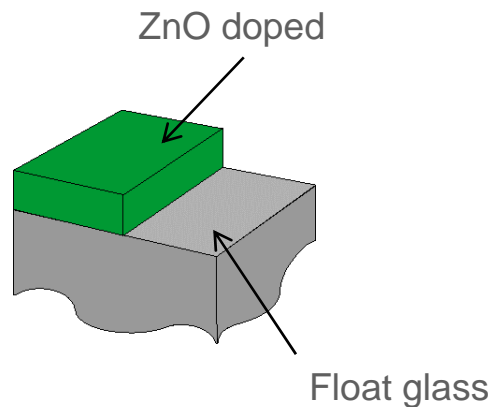
calculated film thicknesses [nm]:



A reflection measurement of a sample with a doped ZnO layer on top of a stainless steel substrate as well as the corresponding fit of the optical model.

Sheet resistance

Calculated **sheet resistance:**
13.82

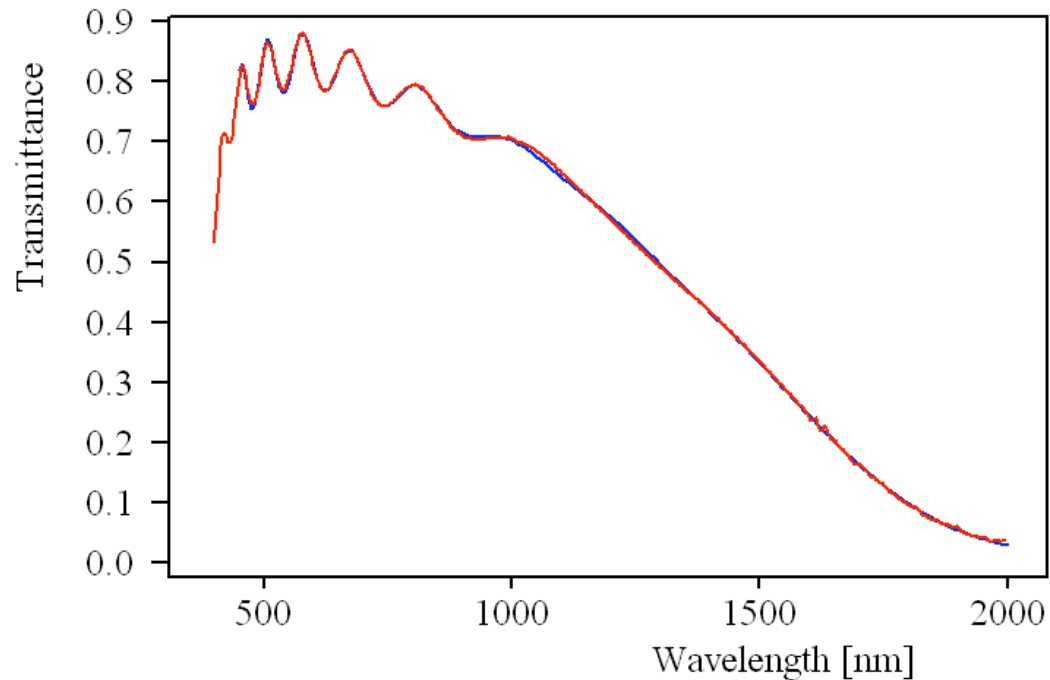


A transmission measurement of a sample with a doped ZnO layer on top of a float glass substrate as well as the corresponding fit of the optical model.

EXAMPLE – Conducting coatings



ITO (Indium Tin Oxide) or d-ZnO on glass



- **Transparent conducting oxides** for touch panel displays, cell phones, solar panels
- Note the **Drude absorption** in the NIR

EXAMPLE – Spectrometry in Agriculture



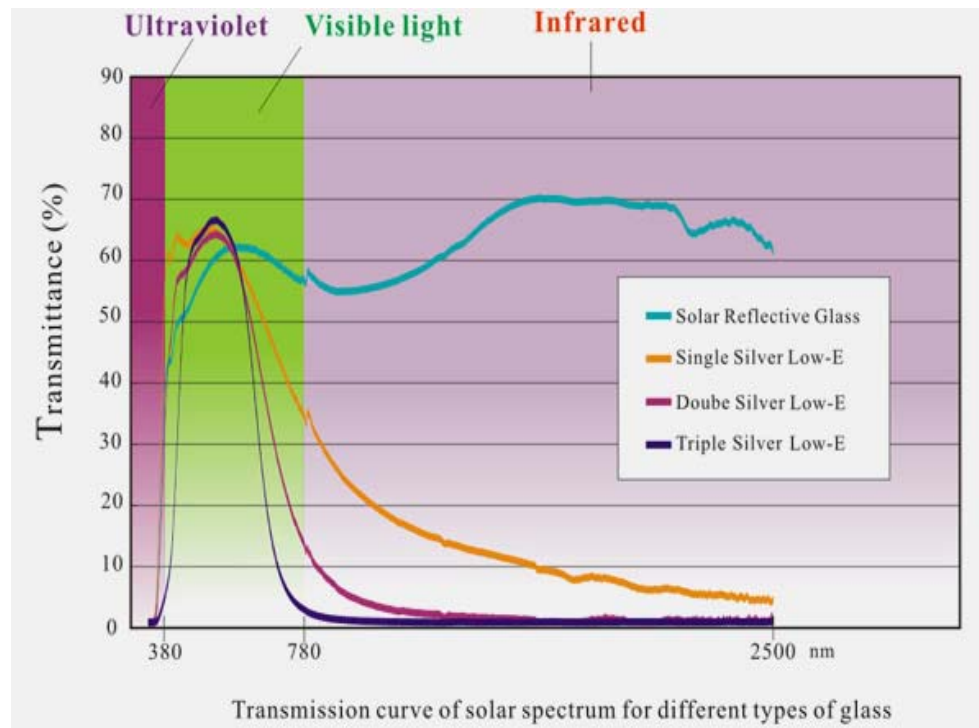
From Detector to Mathematics – m-u-t is a one-stop-shop!



- **In-process analysis** of materials content of manure in turnout
- Integrated device, directly in the flow of manure
- Direct communication with vehicle central control unit
- **Fully compliant with legal regulations.** Flexibility in future developments

EXAMPLE – Coatings on glass

Low-e (emissivity) for architecture glass



- **Reflection of NIR** light reduces heating from sunlight as well as keeping the heat in a building during cold periods.
- Glass is coated with optically **thin layers of silver** that effect transmission in the near infrared, but which allow good transmission in the visible.

The m-u-t Holding Group (m-u-t AG)



As part of m-u-t AG, we provide a broad range product portfolio and three brands for our OEM customers:



- UV / VIS / NIR / MIR & RAMAN
- Spectrometry
- Photometry
- Data Analysis
- Pattern recognition



- Technology
- Machinery
- Software
- Applications

We cover the Full Range of Spectrometric Analysis



The full range of contact-free optical analysis!

Gender / Jobs I



My experience:

Discrimination is generally not the biggest problem, but having **children** is.

In most countries and most families, women take care of the children.

If you do not have the **resources** (good paying job, network of family and friends), it is difficult to stay productive.

Even the **environment and society can be negative**. I live in Southern Germany, where women are still expected to stay home until a child is 3 years old and then work at most ½ time. You must be strong to keep working and not submit to peer pressure. Often it is the stay-at-home moms that are the most discriminatory.

Women are still subject to discrimination and **male aggression**, but in most European countries and the US this is illegal and there are consequences.

Gender / Jobs II



My experience:

Had children late ... **Already had a career and experience** that I could build on.

People remember me (I think more than if I had been a man). If there is only 1 woman in a department of 100, then the bosses know you.

In a science job, if you can prove something by experiment or calculation it is difficult to shoot you down. Example: $1+1=2$ on a math test, but on an English essay it is harder to prove if you did a good or bad job.

In a non-tech job, your 'idea' can be shot down by someone as irrelevant, because it is **subjective**.

If you work hard, show drive, acquire knowledge that no one else has and can share that knowledge with others, then you are valuable whether you are a man or woman!!

My Newest „Job“



What are Ulm's 2 claims to fame?

- 1) We have the tallest church in the world
- 2) Albert Einstein was born in our town!



NEW JOB: Establishing an Albert Einstein Science and Technology Center in ULM!

$$E = mc^2$$



efficient photonic solutions

Many thanks for your attention!