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Systems, Inc.

Baskin Engineering  **UC SANTA CRUZ**



PLANAR OPTICAL WAVEGUIDE COUPLER TRANSFORMERS FOR HIGH-POWER SOLAR ENERGY COLLECTION AND TRANSMISSION

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Outline



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1. Background
2. Unique sputtering technology
3. Amorphous dielectric films
4. Applications
5. Summary

Background and Motivation



A large amount of energy from the sun

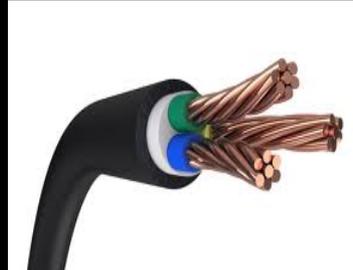
In a single hour the sun delivers the same amount of energy as consumed by all of humanity in a year – about 5×10^{20} J, but it's **highly diluted**

Sun light → Electricity



<http://eath4energy-home-electricity.maxupdates.tv>

Transport



<http://www.ect.coop>

Electricity → Light



Photo Researchers RM/Getty Images

Electricity → Heat



<http://www.allaboutrental.com.au>

Sun light → Light



<http://www.topnews.in/tidal-interaction-making-earth-and-sun-push-each-other-away-2173555>

No transportation



Light → Light



<http://suntunnelskylights.veluxusa.com>

Light → Heat



<http://www.keepbanderabeautiful.org>

Background and Motivation



Concentrated sun light into an optical fiber

Sun light → Concentration “Directional” Transportation Light → Daylighting



<http://www.selftest.net/media/solar/>



Use as light



<http://www.solarstuff.com>



<http://fscreenfresnel.en.busytrade.com>



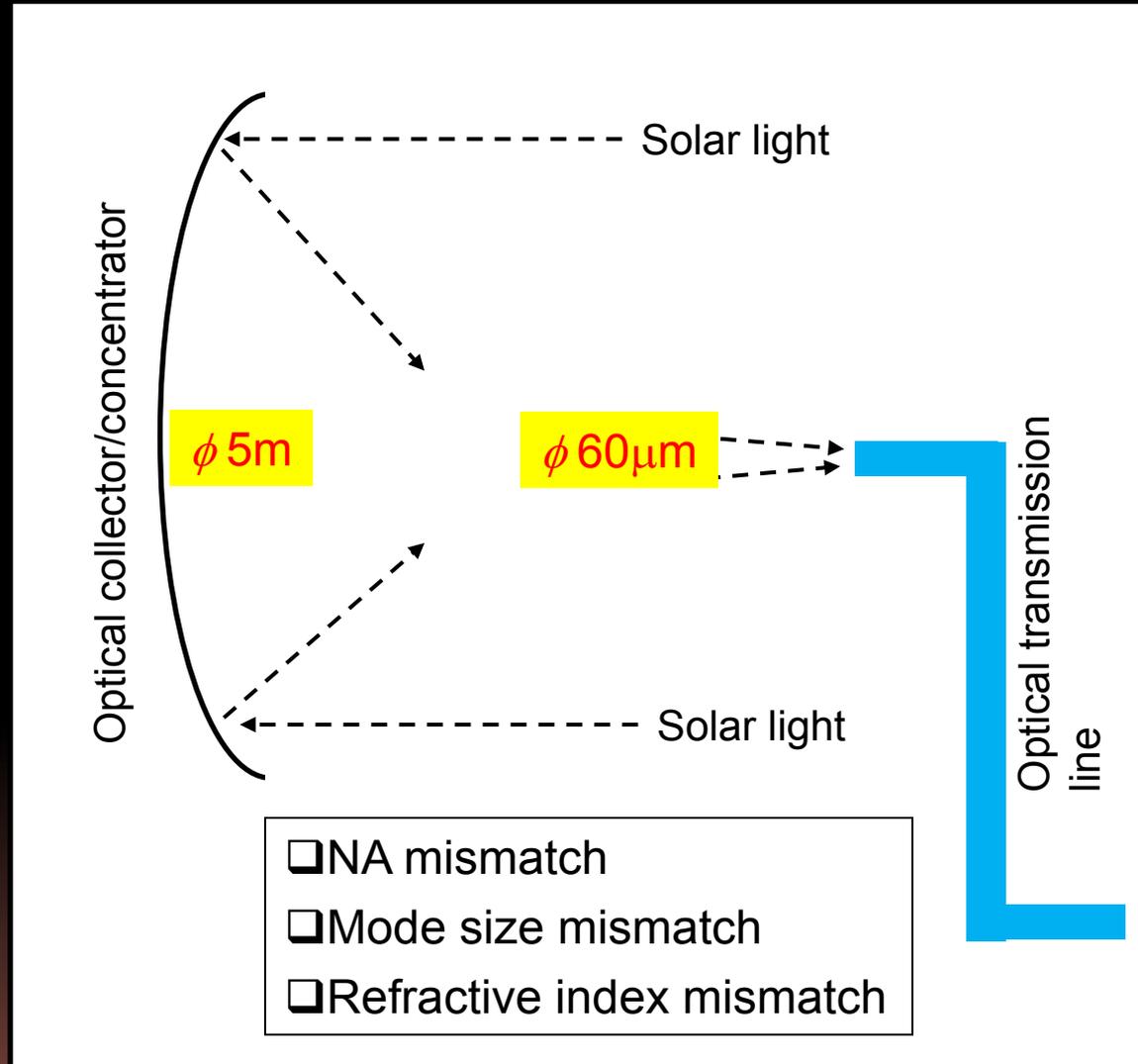
Use as heat or storage for later uses



En.wikipedia.org

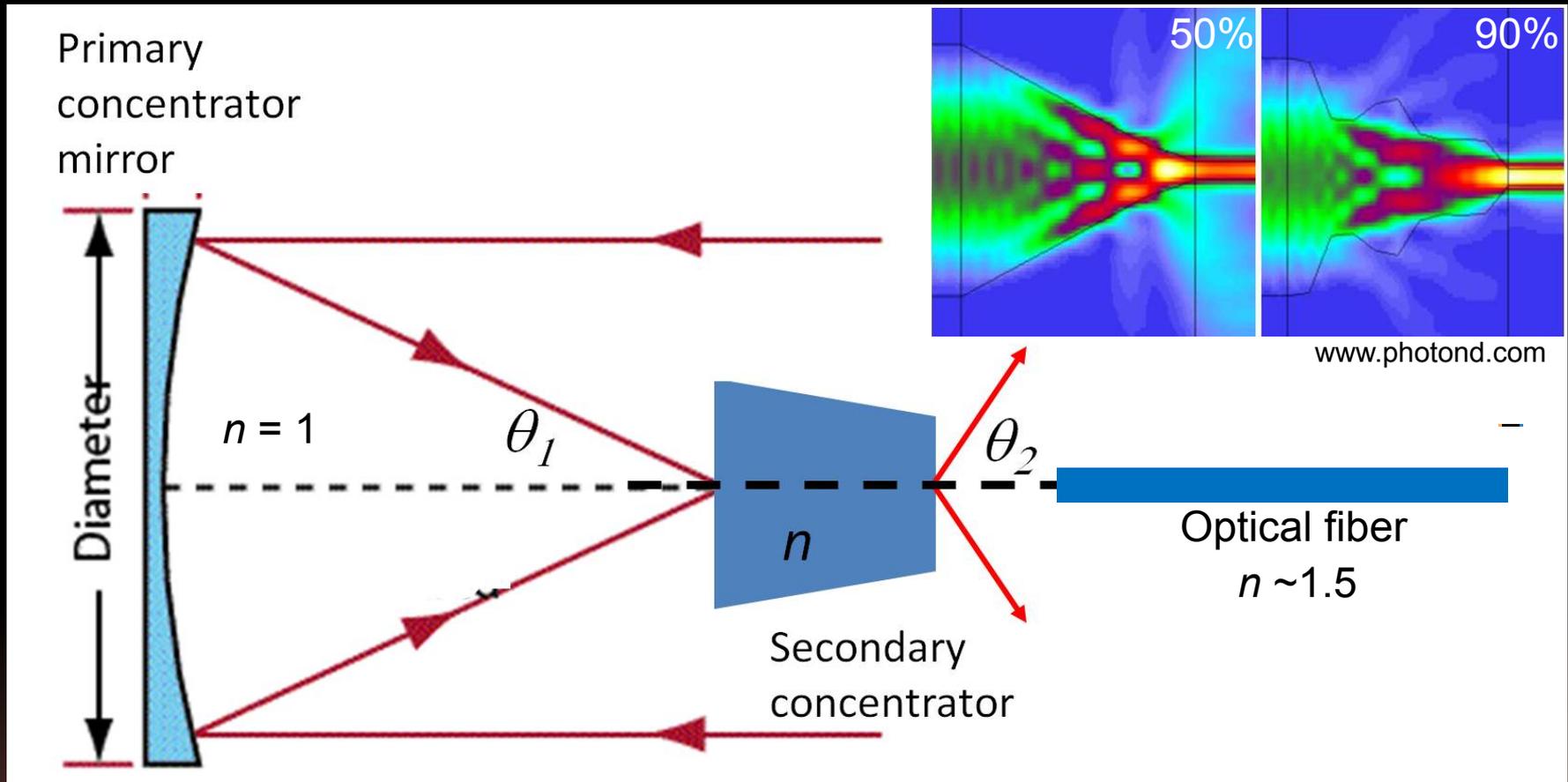
Strategy and Goal

Concentrated sun light into an optical fiber



Strategy and Goal

Concentrated sun light into an optical fiber



Need thin films with $1.4 < n < 2.8$ for 400-1000nm and k as small as possible

Unique Sputtering Technology



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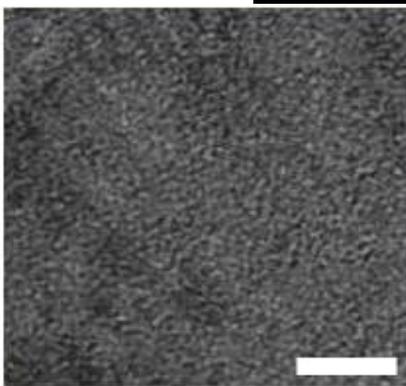
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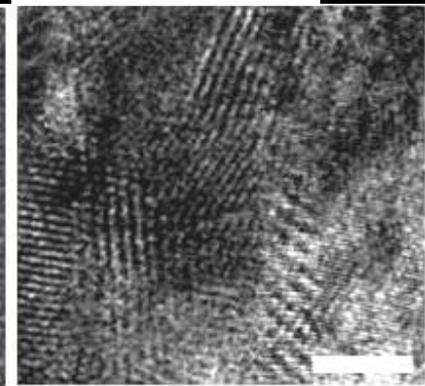
Pulsed DC reactive scanning magnetron sputtering
with AC substrate bias



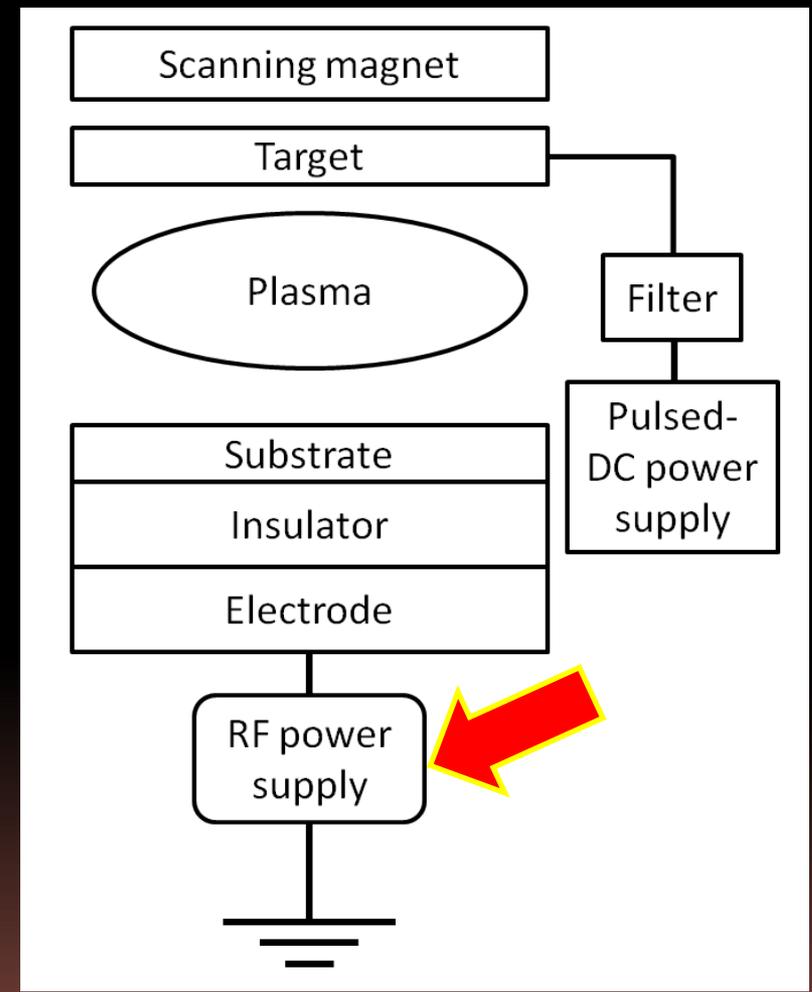
With AC bias



Without AC bias



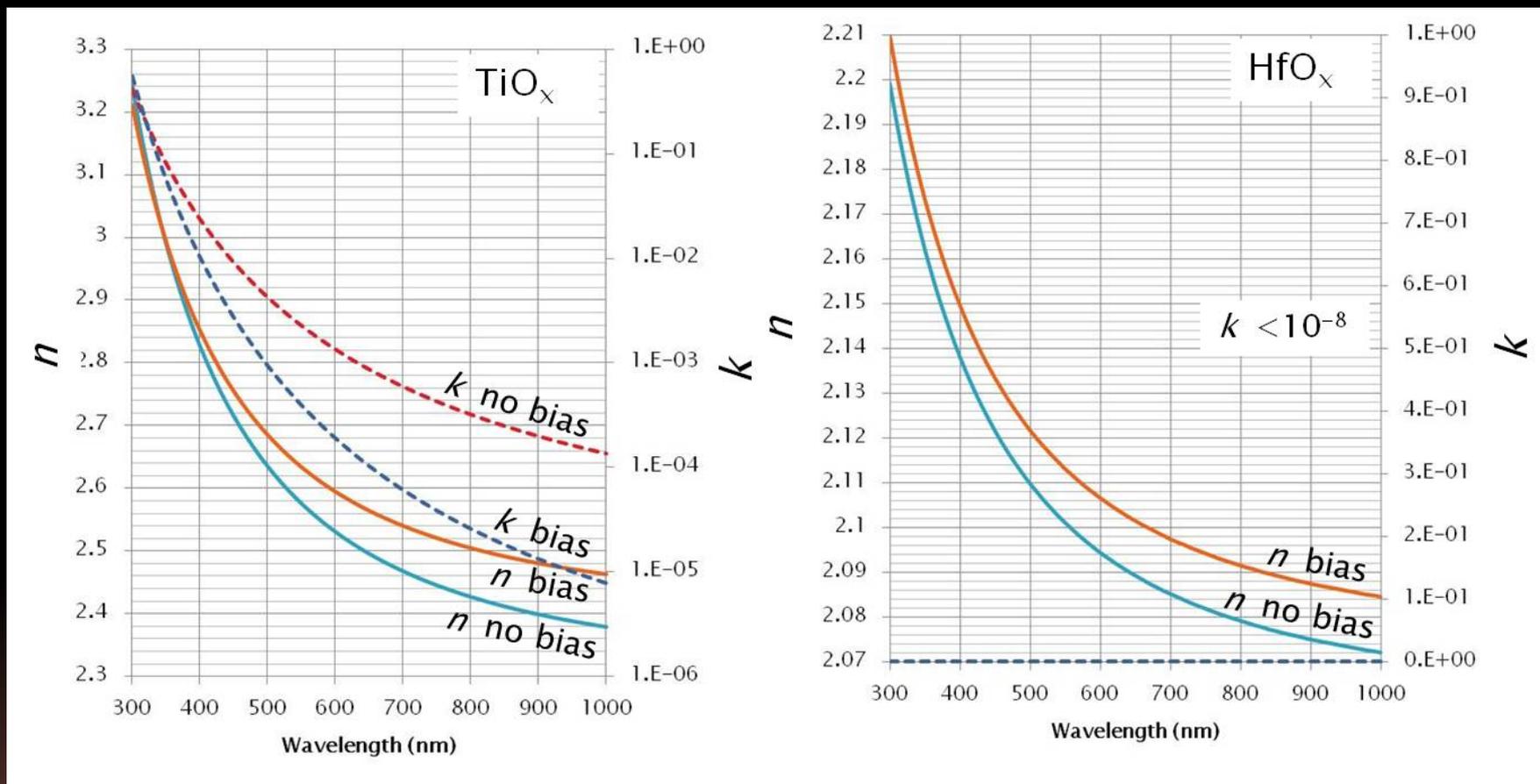
Niobium oxide (TEM, scale bar 5nm)



TiO_x and HfO_x

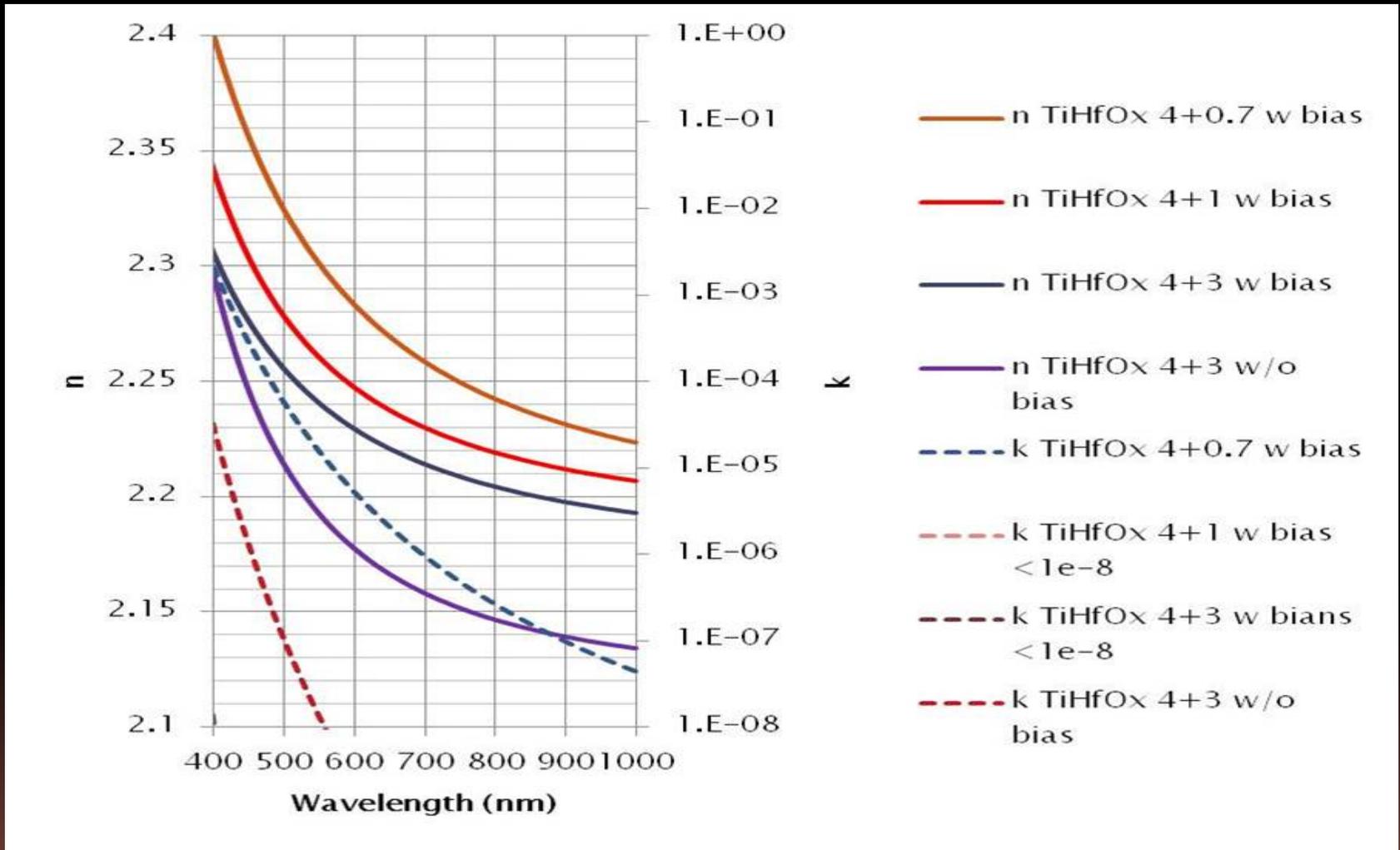


TiO_x and HfO_x: with and without the substrate bias



TiHfOx

TiHfOx: varied sputtering power



Sunlight into an Optical Fiber

Mode size converter/Out-coupler for LED/LD

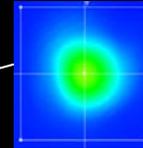
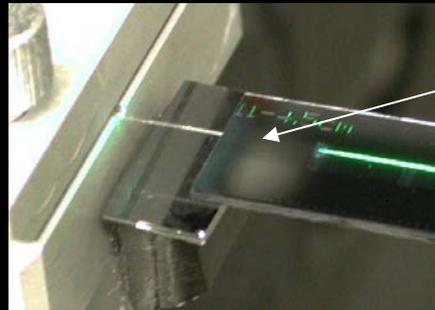


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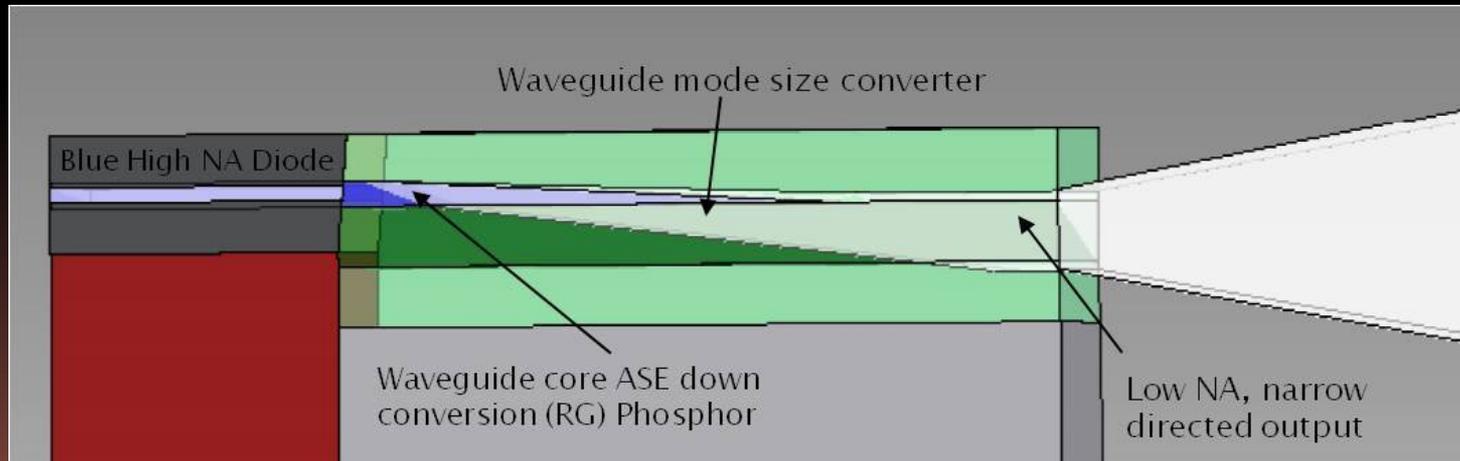
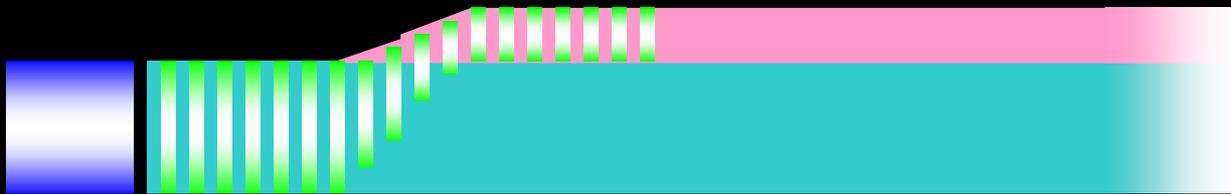
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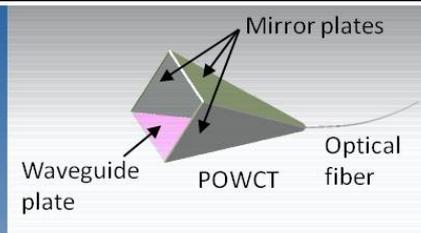
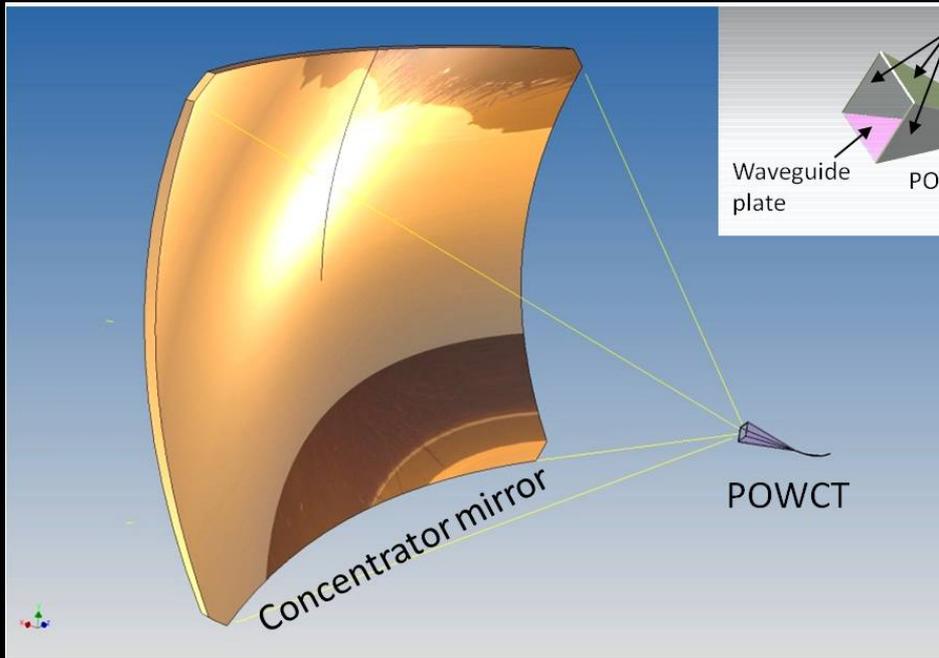
ASL
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Antropy, Inc/Demaray, LLC
US8045832 (Oct. 25, 2011)
US6884327 (Apr. 26, 2005)

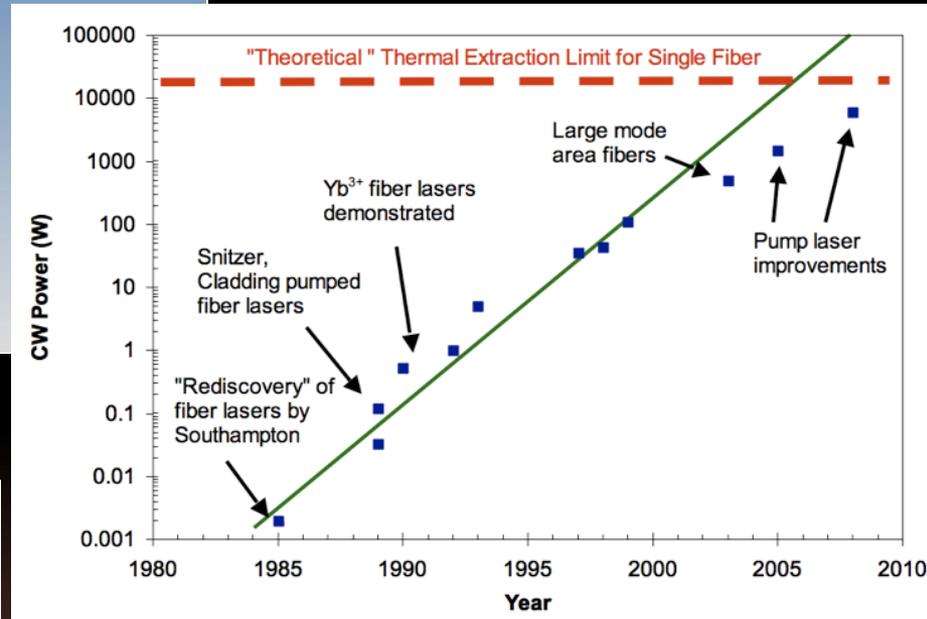
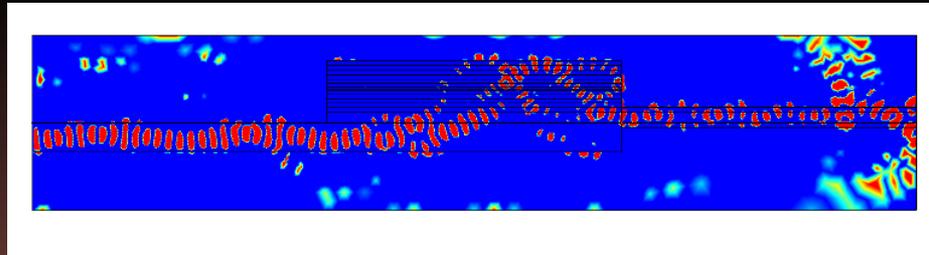


Sunlight into an Optical Fiber Couplers



Foro Energy, Inc.
(Littleton, CO)

The mirror plates will be AR coated with a single layer with refractive index continuously varying



Jay W. Dawson
National Ignition Facility and Photon Sciences Directorate,
Lawrence Livermore Nat. Lab.

Sunlight into an Optical Fiber

Ultimate application



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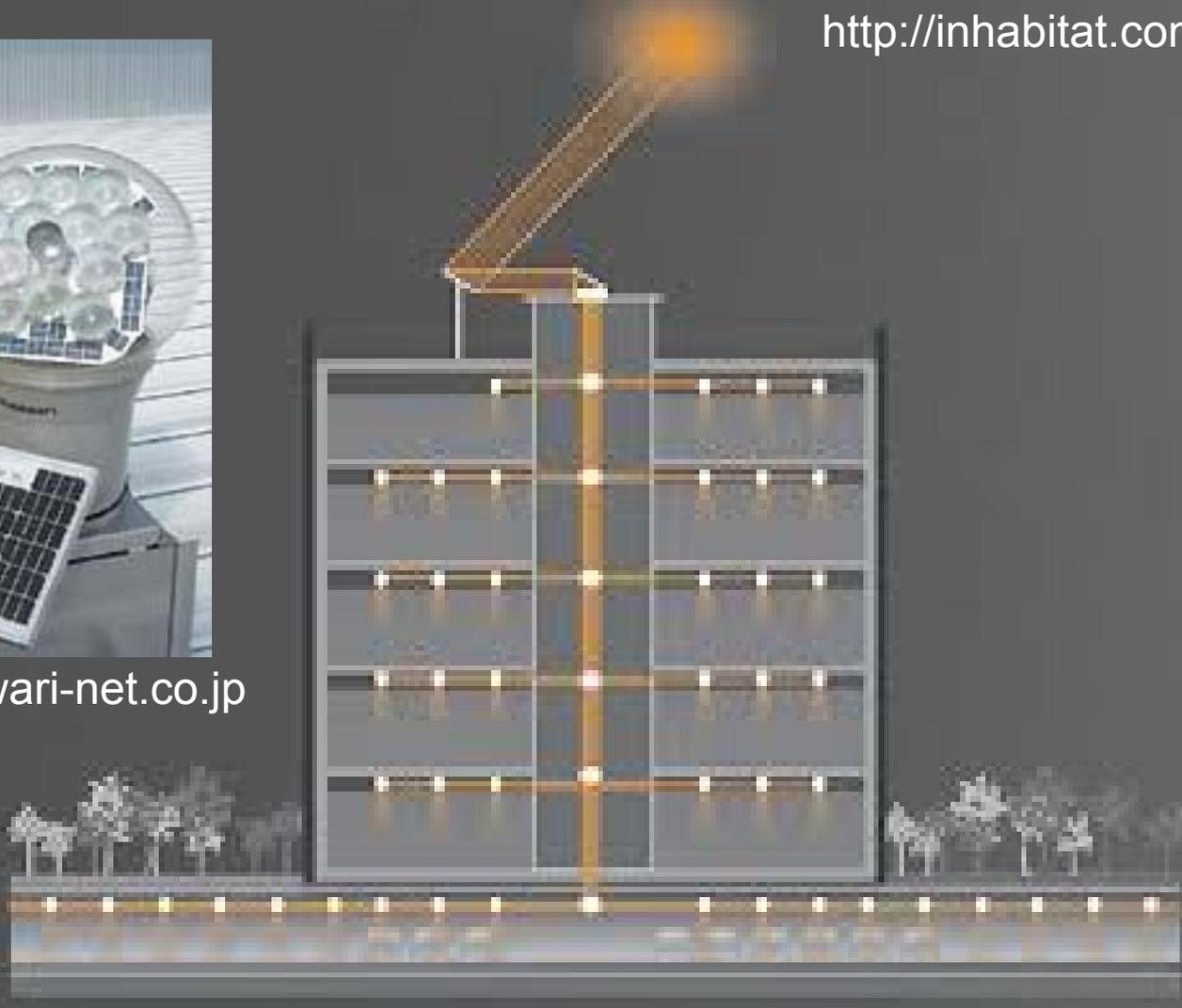
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<http://www.himawari-net.co.jp>

<http://inhabitat.com>



Sunlight into an Optical Fiber

Really ultimate applications

Eliminate heat engine



<http://mcensustainableenergy.pbworks.com>

Eliminate working fluid and pipes



www.getsolar.com

- 1m² concentrator for solar daylighting
- 25m² concentrator for solar thermal power generation
- 25kW in an optical power over 100m with >90% transmission



Minimize emission loss and eliminate working liquid/vapor

www.rainbowskill.com

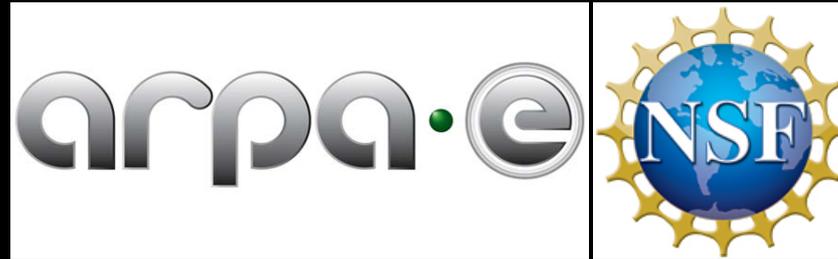


Ernest and Nobby at NREL, Golden CO (Dec '12)

Demaray and Kobayashi at the NREL solar furnace

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