

Academic Writings and Presentations

Presentations

Part II - Posters

Xing Sheng 盛兴

**Electronic Engineering
Tsinghua University**



xingsheng@tsinghua.edu.cn

Outline

- **Why to do presentations?**
- **How to give a PowerPoint presentation?**
 - **how to prepare your slides**
 - **how to present your talk**
- **How to give a Poster presentation?**

Posters

- Good for one-to-one communication
- Less stress



Posters

- **Only focus on ONE topic**
- **Use images and graphs, less texts**
- **Structure**
 - **Title, name, affiliation, contact**
 - **Introduction**
 - **Results**
 - **Summary**
 - **References**
 - **Acknowledgements**
- **Formats similar to PowerPoint slides**

A Bad Example

**PIGS IN SPACE:
EFFECT OF ZERO GRAVITY AND
AD LIBITUM FEEDING ON WEIGHT
GAIN IN CAVIA PORCELLUS**

Colin B. Purrington*
6673 College Avenue, Swarthmore, PA 19081 USA

ABSTRACT:
One ignored benefit of space travel is a potential elimination of obesity, a chronic problem for a growing majority in many parts of the world. In theory, when an individual is in a condition of zero gravity, weight is eliminated. Indeed, in space one could conceivably follow ad libitum feeding and never even gain an gram, and the only side effect would be the need to upgrade one's stretchy pants ("exercise pants"). But because many diet schemes start as very good theories only to be found to be rather harmful, we tested our predictions with a long-term experiment in a colony of Guinea pigs (*Cavia porcellus*) maintained on the International Space Station. Individuals were housed separately and given unlimited amounts of high-calorie food pellets. Fresh fruits and vegetables were not available in space so were not offered. Every 30 days, each Guinea pig was weighed. After 5 years, we found that individuals, on average, weighed nothing. In addition to weighing nothing, no weight appeared to be gained over the duration of the protocol. If space continues to be gravity-free, and we believe that assumption is sound, we believe that sending the overweight — and those at risk for overweight — to space would be a lasting cure.

INTRODUCTION:
The current obesity epidemic started in the early 1980s with the invention and proliferation of elastane and related stretchy fibers, which released wearers from the rigid constraints of clothes and permitted monthly weight gain without the need to buy new outfits. Indeed, exercise today for hundreds of million people involves only the act of wearing stretchy pants in public, presumably because the constrictive pressure forces fat molecules to adopt a more compact tertiary structure (Xavier, 1965).
Luckily, at the same time that fabrics became stretchy, the race to the moon between the United States and Russia yielded a useful fact: gravity in outer space is minimal to nonexistent. When gravity is zero, objects cease to have weight. Indeed, early astronauts and cosmonauts had to secure themselves to their ships with seat belts and sticky boots. The potential application to weight loss was noted immediately, but at the time travel to space was prohibitively expensive and thus the issue was not seriously pursued. Now, however, multiple companies are developing cheap extra-orbital travel options for normal consumers, and potential travelers are also creating new ways to pay for products and services that they cannot actually afford. Together, these factors open the possibility that moving to space could cure overweight syndrome quickly and permanently for a large number of humans.
We studied this potential by following weight gain in Guinea pigs, known on Earth as fond of ad libitum feeding. Guinea pigs were long envisioned to be the "Guinea pig" of space research, too, so they seemed like the obvious choice. Studies on humans are of course desirable, but we feel this current study will be critical in acquiring the attention of granting agencies.

MATERIALS AND METHODS:
One hundred male and one hundred female Guinea pigs (*Cavia porcellus*) were transported to the International Space Laboratory in 2010. Each pig was housed separately and deprived of exercise wheels and fresh fruits and vegetables for 48 months. Each month, pigs were individually weighed by duct-taping them to an electronic balance sensitive to 0.0001 grams. Back on Earth, an identical cohort was similarly maintained and weighed. Data was analyzed by statistics.

RESULTS:
Mean weight of pigs in space was 0.0000 ± 0.0002 g. Some individuals weighed less than zero, some more, but these variations were due to reaction to the duct tape, we believe, which caused them to be alarmed push briefly against the force plate in the balance. Individuals on the Earth, the control cohort, gained about 240 grams ($p = 0.0002$). Males and females gained a similar amount of weight on Earth (no main effect of sex), and size at any point during the study was related to starting size (which was used as a covariate in the ANCOVA). Both Earth and space pigs developed substantial distaste (double chins) and were lethargic at the conclusion of the study.

CONCLUSIONS:
Our view that weight and weight gain would be zero in space was confirmed. Although we have not replicated this experiment on larger animals or primates, we are confident that our result would be mirrored in other model organisms. We are currently in the process of obtaining necessary human trial permissions, and should have our planned experiment initiated within 80 years, pending expedited review by local and Federal IRBs.

ACKNOWLEDGEMENTS:
I am grateful for generous support from the National Research Foundation, Black Hole Diet Plans, and the High Fructose Sugar Association. Transport flights were funded by SPACE-EXES, the consortium of wives divorced from insanely wealthy space-flight startups. I am also grateful for comments on early drafts by Mariana Athletic Club, Corpus Christi, USA. Finally, sincere thanks to the Cuy Foundation for generously donating animal care after the conclusion of the study.

LITERATURE CITED:
NASA. 1962. Project STS-XX: Guinea Pigs. Leaked internal memo.
Sekulic, S.R., D. D. Likac, and N. M. Naumovic. 2005. The Fetus Cannot Exercise Like An Astronaut: Gravity Loading Is Necessary For The Physiological Development During Second Half Of Pregnancy. *Medical Hypotheses*, 64:221-226.
Xavier, M. 1965. Elastane Purchases Accelerate Weight Gain in Case-control Study. *Journal of Obesity*, 2:23-40.

Q: Any problems?

A Good Example

Efficient and non-lithographic light trapping structures in thin film Si solar cells

X. Sheng¹, J. Liu¹, I. Kozinsky², J. Michel¹, A. M. Agarwal¹, and L. C. Kimerling¹

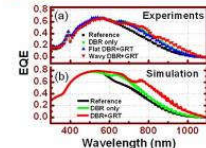
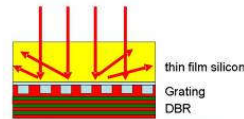
¹Department of Materials Science and Engineering, Massachusetts Institute of Technology, Cambridge, MA, 02139

²Robert Bosch LLC, Research and Technology Center, Palo Alto, CA 94304

INTRODUCTION

Previous work on Textured Photonic Crystal (TPC):

- Grating (by lithography): diffract light into oblique angles
- DBR (Distributed Bragg Reflector) achieve ~100% reflectivity in near-IR range
- Efficiency enhancement ~ 20% for 5 μm silicon solar cell, compared to the bare cell without back structure



New design:

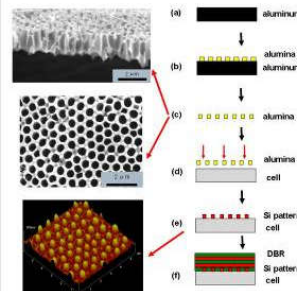
- Fabricate the grating pattern by using low-cost self-assembled anodic aluminum oxide (AAO) as a deposition mask

L. Zeng, et al. Appl Phys Lett 99, 111111 (2006)
 L. Zeng, et al. Appl Phys Lett 93, 231105 (2008)
 P. Demmel, et al. Opt Express 15, 16186 (2007)
 N. Feng, et al. IEEE Trans Electron Devices 54, 156 (2007)
 Sheng, et al. 34th IEEE PVSC, 003395 (2009)

FABRICATION

The process steps:

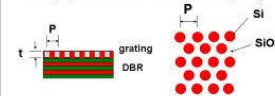
- 1) Two-step anodization of Al foil in citric acid
- 2) Use the porous alumina membrane as a deposition mask
- 3) Deposit Si hexagonal pattern by evaporation
- 4) DBR deposition by PECVD (5 periods of 40nm a-Si and 130nm SiO₂)



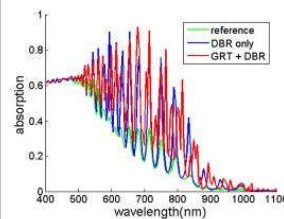
SIMULATION

Model

- 1.5 μm thin film crystalline silicon with 400nm back TCO contact
- High index Si hexagonal cylinders (n=3.5) in low index SiO₂ matrix (n=1.4) (Period = P, Thickness = T)
- DBR (5 periods of 40nm a-Si and 130nm SiO₂ stack)



Simulated absorption spectra for different back structures (For grating: P=700nm, T=120nm)

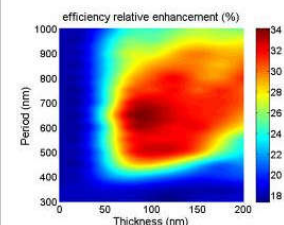


Efficiency prediction from

$$J = e \int \alpha(\lambda) \cdot A(\lambda) d\lambda = \frac{2\pi e (n^2 + 1) E_g^2 kT}{h^3 c^2} \exp\left(\frac{eV - E_g}{kT}\right)$$

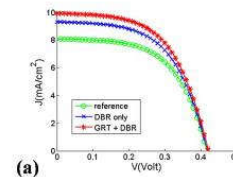
Optimized structures and performance (compared to reference cell without reflector):

- 1) DBR shows ~18% relative efficiency increase
- 2) Grating + DBR shows ~34% relative efficiency increase, with period ~700nm and thickness ~100nm

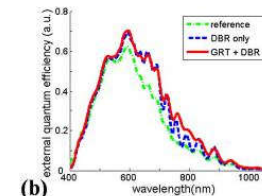


EXPERIMENTAL RESULTS

JV and EQE measurements were used to validate the light trapping effect using 1.5 μm microcrystalline Si cells:



Measured quantum efficiency spectra (resolution ~10 nm):



The grating+DBR increases the photo response at red and near-IR wavelength ranges, in accordance with the simulation results.

CONCLUSION

Achieve light trapping in thin film silicon using the self-assembled AAO membrane as a mask:

- low-cost, non-lithographic fabrication
- numerical simulations show a maximum of 34% increase for 1.5μm thin film Si
- experimental validation by JV and EQE measurements, 21% efficiency increase achieved by combining self-assembled grating and DBR in a prototyped device

ACKNOWLEDGMENTS

This work was supported by Robert Bosch LLC through MIT Energy Initiative.

Thank you for your attention