Sports technology

Buzzwords and opportunities!

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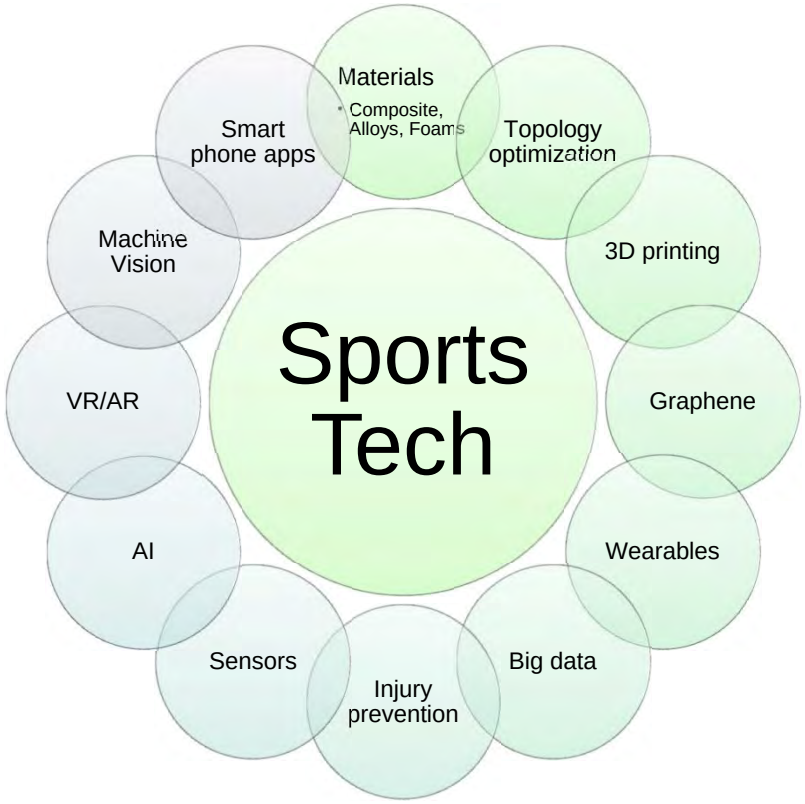
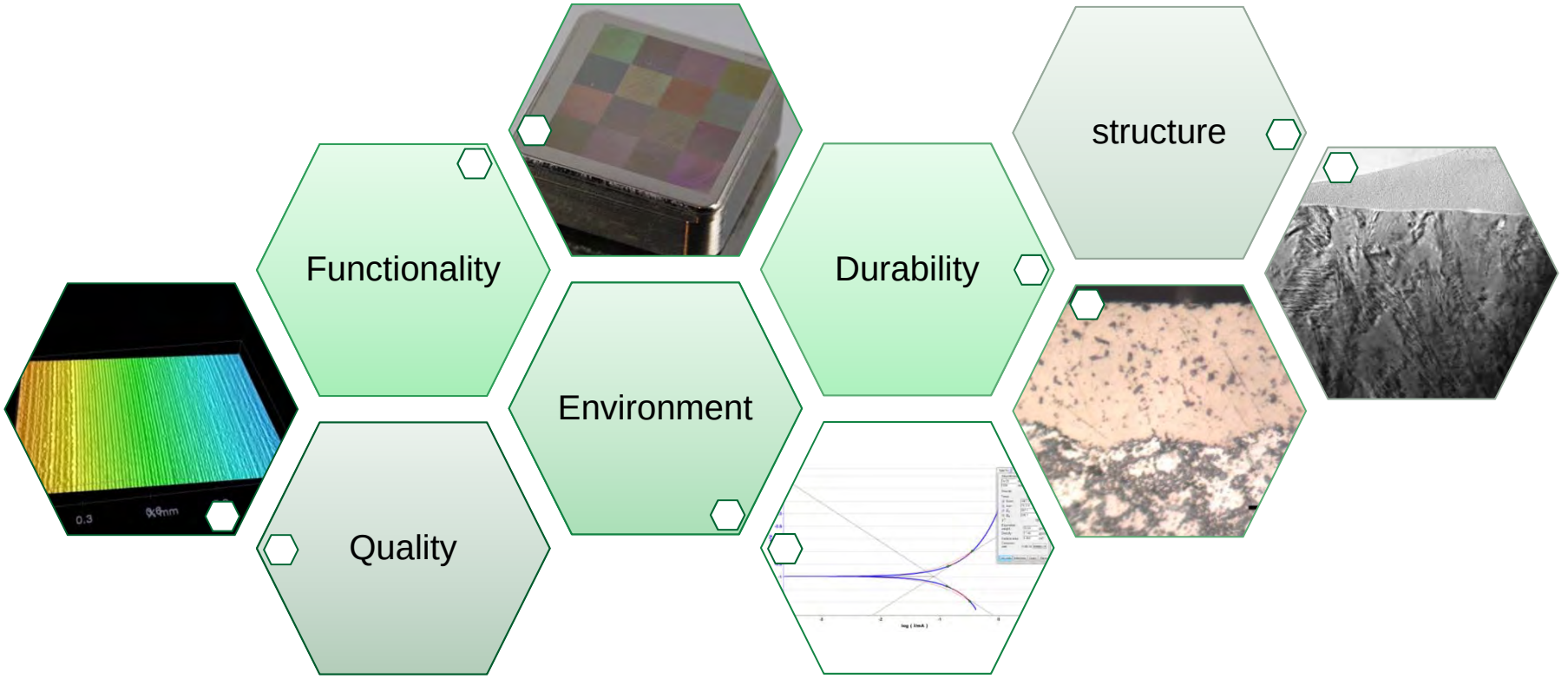
IPU

”Hot topics” in sports technology



Materials and surfaces – my home turf…



But I’m surrounded by some pretty awesome people!

IPU; the business oriented technology expert, integrating core research in solving industry challenges

IPU

- 25 full-time engineers, 90+ associated consultants
- Located at the Technical University of Denmark (DTU)
- Private, independent, non-profit foundation, since 1956

IPU Mission

IPU seeks to strengthen our clients’ business by creating innovative, sustainable, and financially viable technical solutions to industry challenges

Sports technology vs. the marketing machine

FACTS

SPEED:	superfast
TERRAIN:	versatile, piste and off-piste
SKILL:	Top skiers
STYLE:	excellent skiing technique
LENGTHS:	153/162/171/180/189
RADIUS:	16,4 @ Length 180
SIDECUT:	133 / 93 / 115 @ Length 180

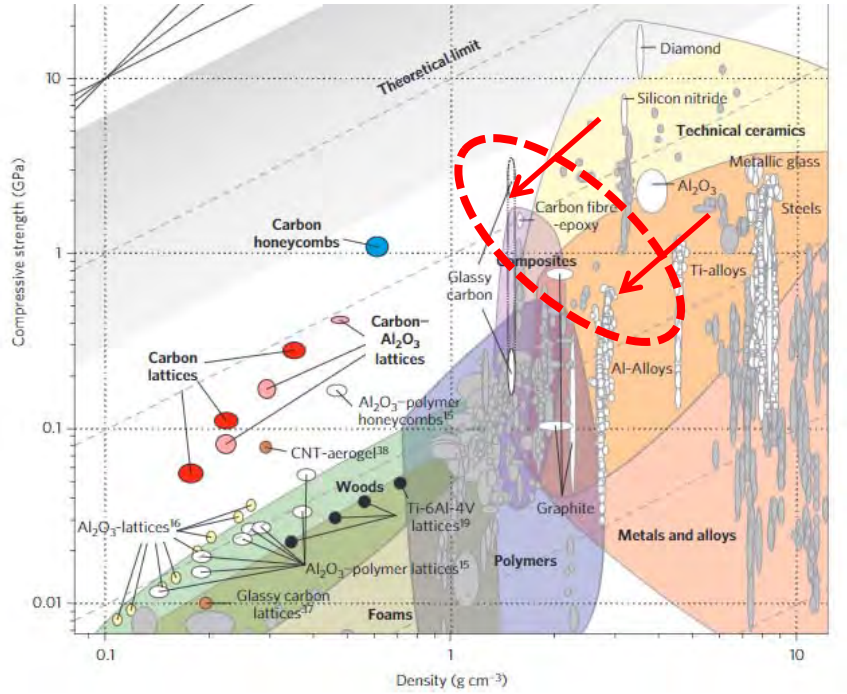
FEATURES

- Graphene-KOROYD-Carbon Sandwich Cap Construction
- KARUBA Light Weight Wood Core
- Topless Tech
- Split Sidewalls
- Structured diecut UHM C Base
- Tip-Tail Rocker

www.head.com

Buzzword: Carbon fibre composites

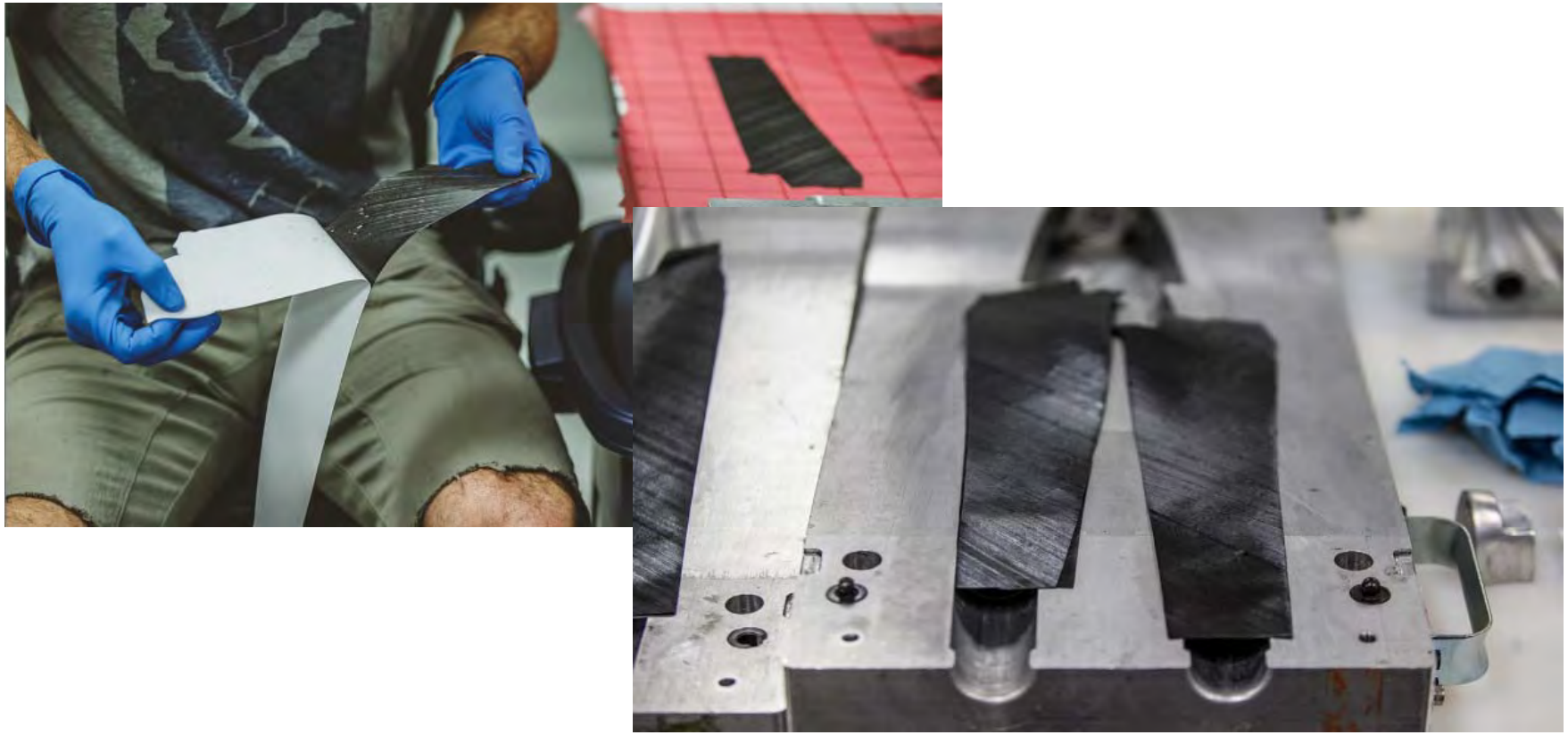
Material comparison plot for compressive strength versus density.



Nature Materials 15(4):438–443 · February 2016

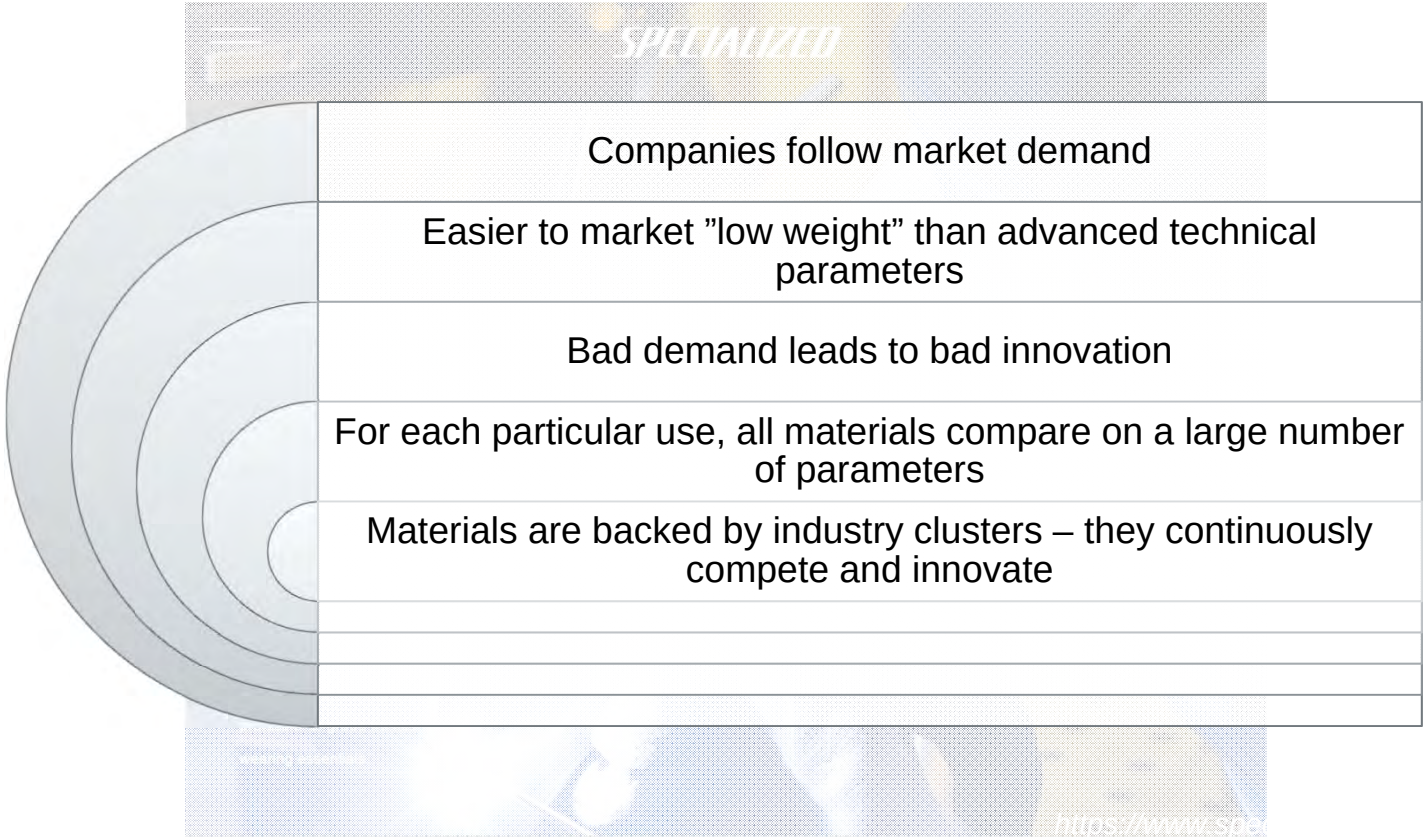
- Metals are isotrope (same properties in all directions)
- Composites are anisotrope, and hence this diagram is only valid in the fiber direction

Buzzword: Carbon fibre composites



https://www.specialized.com

Carbon fibre composites are fantastic – but only for some applications!

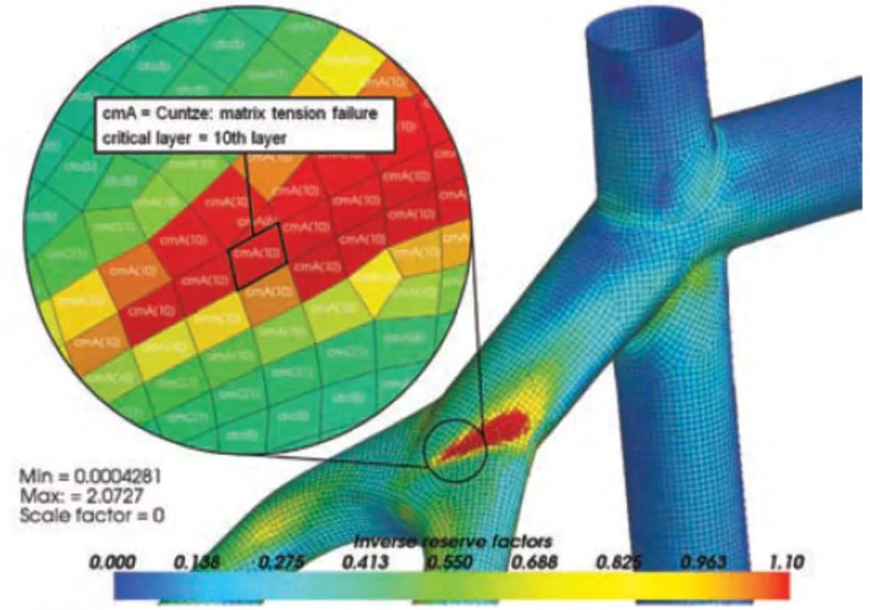


Opportunities: Advanced FEA software for modelling composites

- Composite tools are being implemented into Finite Element Analysis softwares, allowing incorporation of production processes and fiber direction in the modelling
- This allows better prediction of design efficiency and control of the processes.
- Good feature article on this is found on www.engineering.com


How to Design the Lightest Possible Bike – And Still Sleep at Night

Fashion models don't worry about their weight as much as professional cyclists. In the elite levels of cycling, lightweighting takes on a religious significance. Every gram on a serious rider and their bike is blessed in its removal or absence. Racers go crazy: dieting, drilling holes in their bikes,throwing away water bottles during a ride... anything in their desperation to get an edge on the competition.



ANSYS results of a carbon fiber frame analysis showing inverse reserve factor using Cuntze failure criteria. (Image courtesy of ANSYS)

http://www.engineering.com/DesignSoftware/DesignSoftwareArticles/ArticleID/14480/How-to-Design-the-Lightest-Possible-Bike-And-Still-Sleep-at-Night.aspx

Know more about composites and modelling?

Composites and testing

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Finite element analysis

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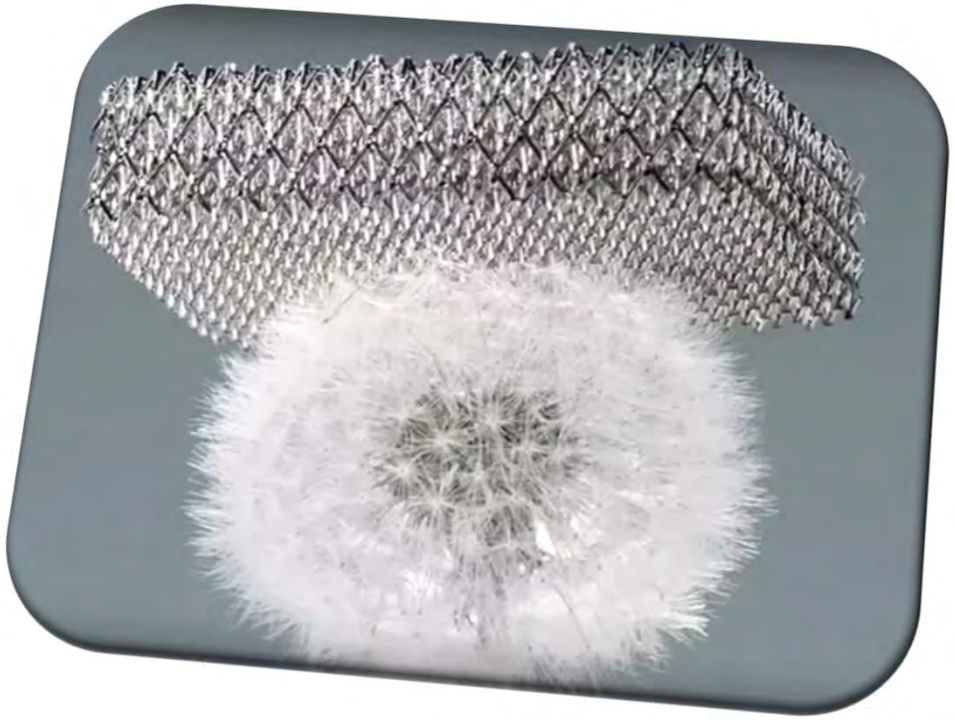
All that was pretty conventional

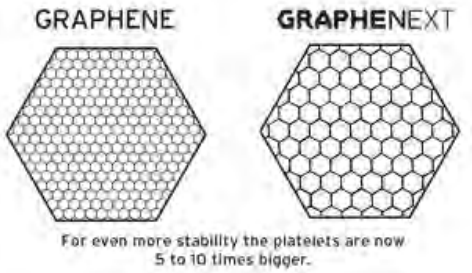
– whats coming up?



Graphene, wonder material of the future – buzzword or fantastic?

Patent US 8894517 B2 ”Sporting goods with graphene material”

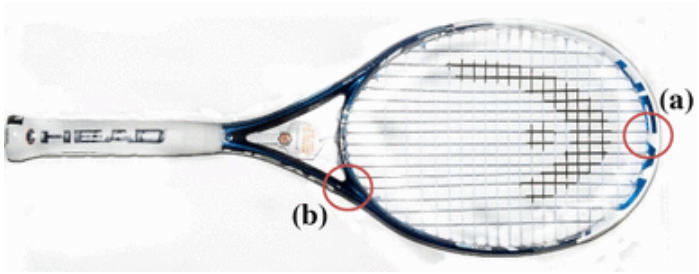
10 years ago it was nanotubes – now it’s graphene…



Graphene – buzzword or fantastic?

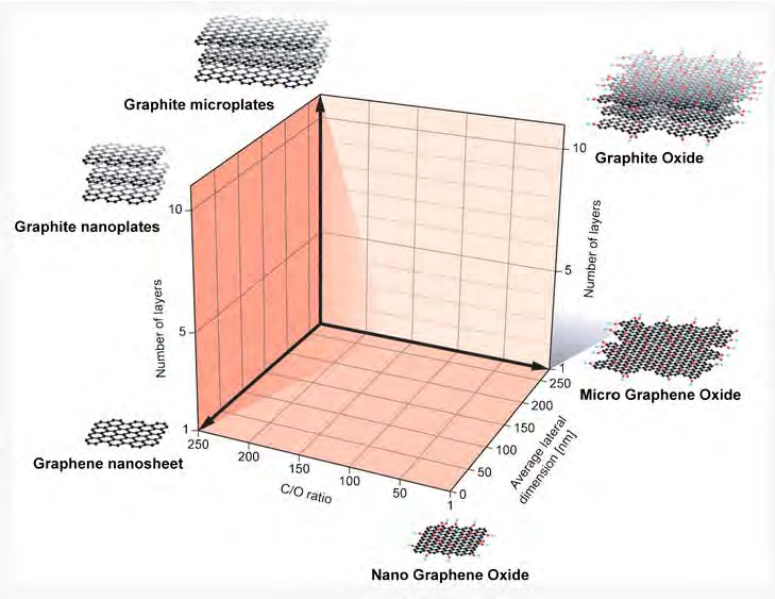
guardian.co.uk


HEAD
GRAPHENE TOUCH
HEAR THE DIFFERENCE.
CONVENTIONAL CARBON
GRAPHENE TOUCH



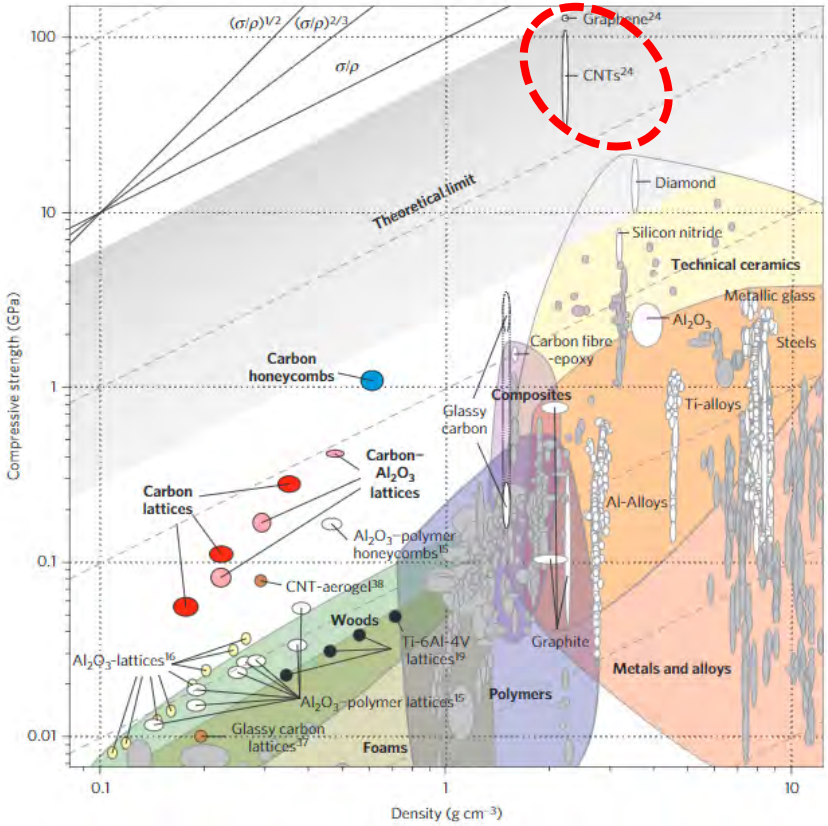
…It was concluded that … indication that some type of graphene-based material had been added to the resin-rich region of the racquet where the shaft meets the racquet head.

…This implies that graphene nanoplatelets, or more correctly, ***graphite nanoplatelets****, have been added to the epoxy resin*



R. J. Young & M. Liu, J Mater Sci (2016) 51:3861–3867

Material comparison plot for Strength versus density.



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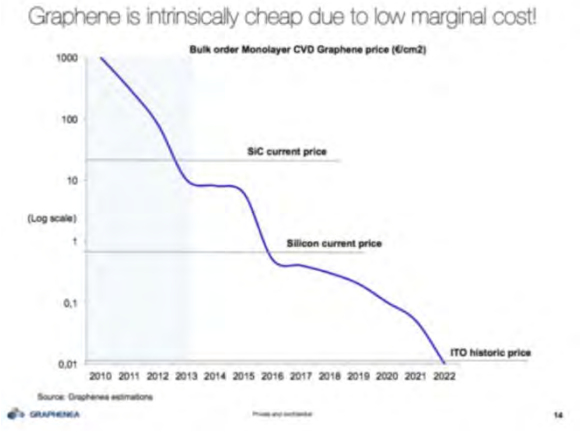
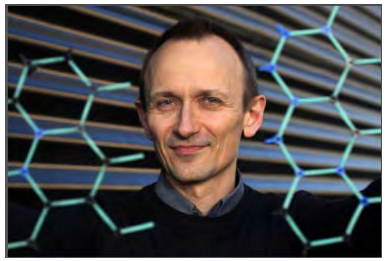
Graphene – just another buzzword, or the wonder material?

- First came carbon nanotubes – now graphene. Will they ever be put into large scale use?
- Main difference is the production methods:
  - Carbon nanotubes are difficult to control and upscale – hence they have not found broad use so far
  - Opportunity:Graphene can be exfoliated from graphite
  - Production methods needs to mature, but price for exfoliated graphene is drastically reduced. Astronomical investments are currently being made!
- Fantastic possibilities for providing disruptive electronic, thermal, barrier and mechanical properties.
- Depending on the use- correct specification of the type/quality of graphene, dispersion, and edge functionality must be made



Know more about graphene?



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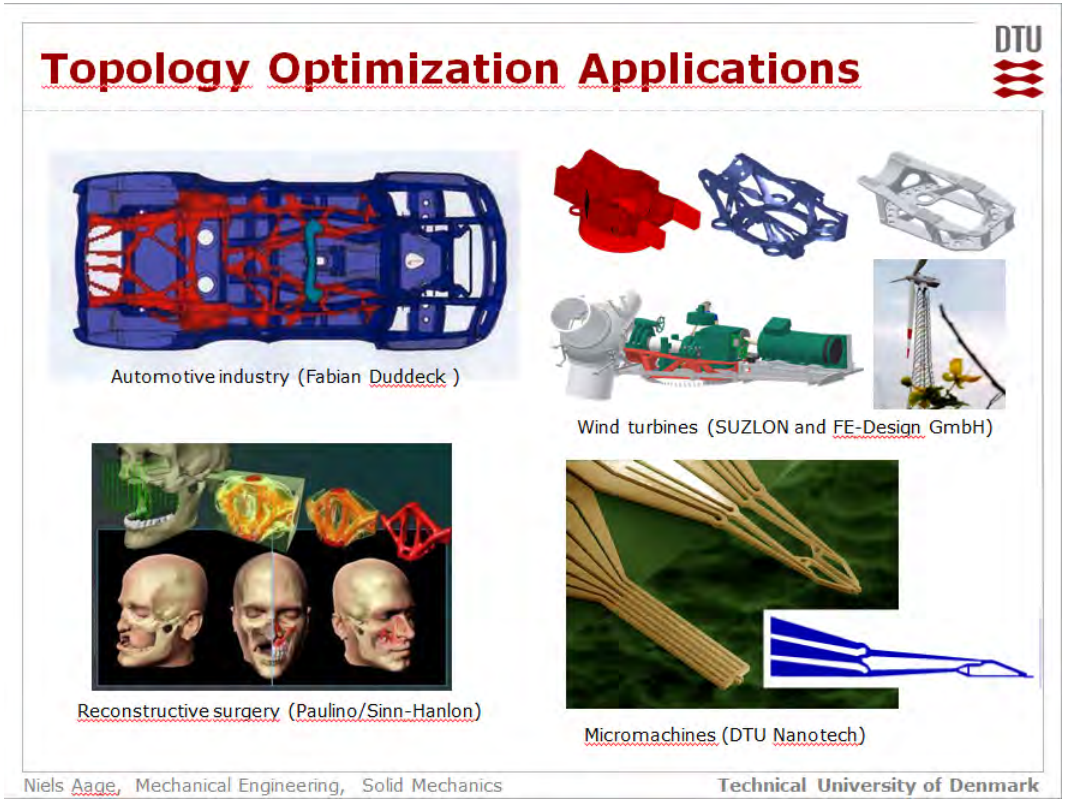
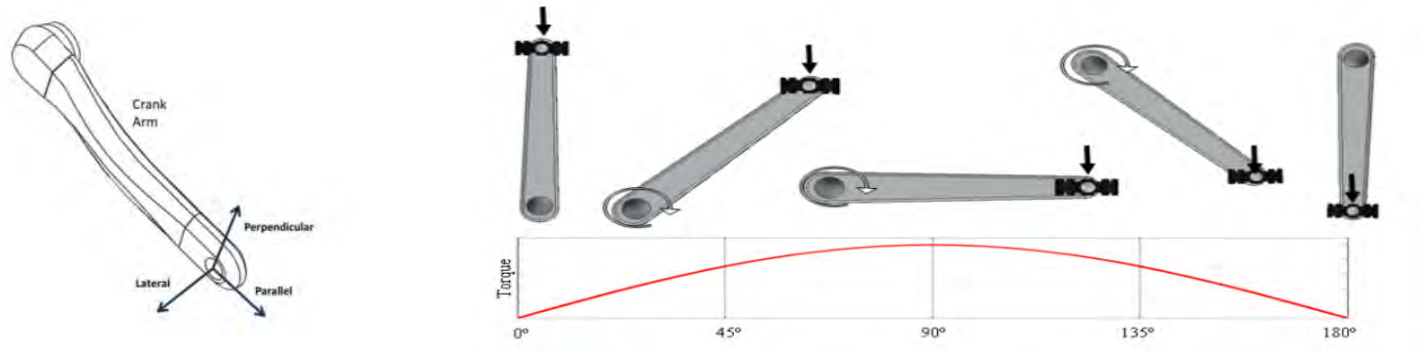
”When technologies are being used for marketing as the main selling point, you should usually be cautious. When disruptive technologies, such as ex. graphene and carbon nanotubes, are being truly exploited, the rule of thumb is that you don’t hear about it. You just see fantastic new products”

Topology optimization

Topology optimization – not a buzzword, but pretty awesome!

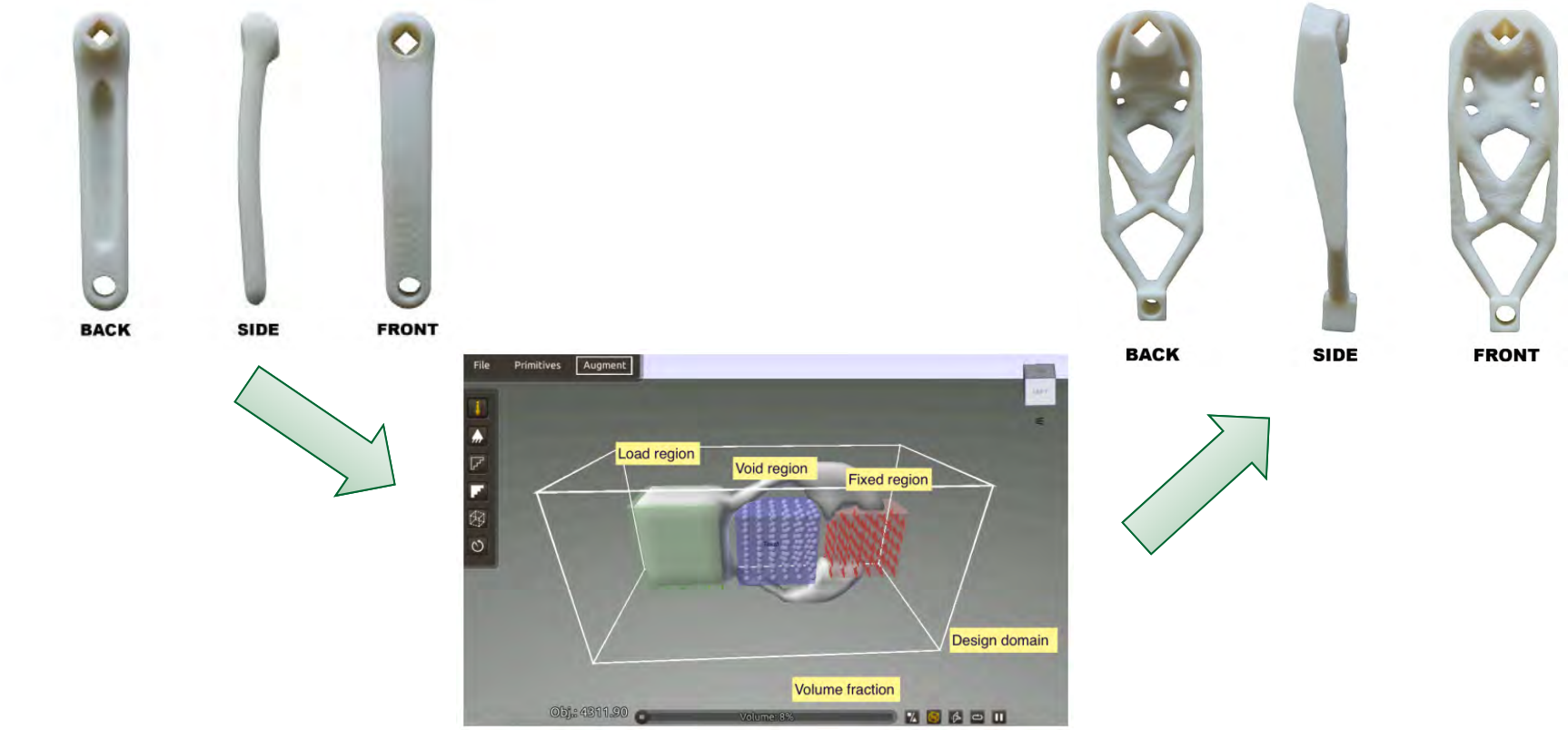


Topology optimization of bike crank arm (simplified)



M. Malik, Bachelor thesis, DTU/IPU 2017

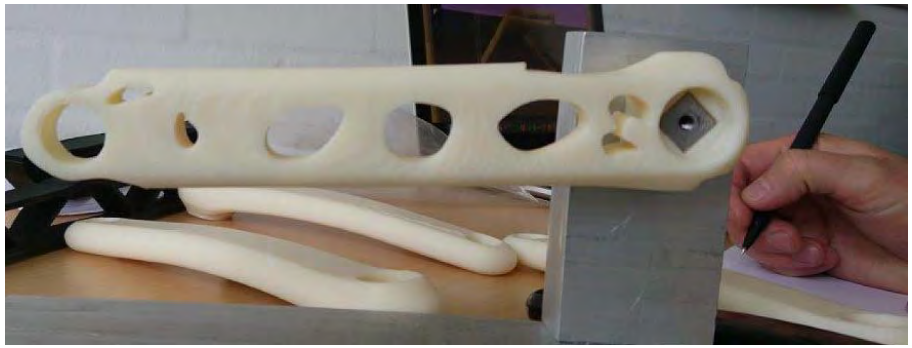
Topology optimization of bike crank arm (simplified)



M. Malik, Bachelor thesis, DTU/IPU 2017

Topology optimization

- The top-opt methodology and the toos available have matured immensely during the last couple of years.
- Research is being done – combining optimization of mechanical and aerodynamic performance
- Computer power now meets the requirements for real life use
- 3D printing is one of the promising technologies for realizing the obtained structures!
- Top-opt can go very wrong!



Know more about topology optimization?

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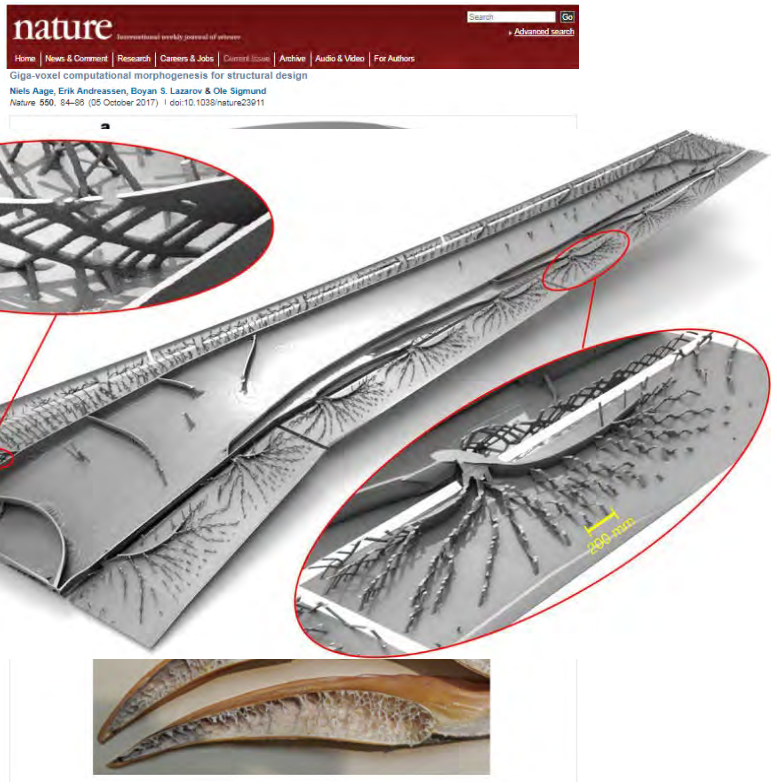

N. Aage et. Al, Nature 550, 84–86 (05 October 2017)

Thanks for your attention!