



Digital Food
Processing Initiative

DFPI

3D FOOD PRINTING

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Unilever workshop

Wageningen, 30 November 2018



Wageningen University & Research



WAGENINGEN
UNIVERSITY & RESEARCH



Wageningen Food & Biobased Research

Applied research for sustainable innovations



Food & Nutrition
security



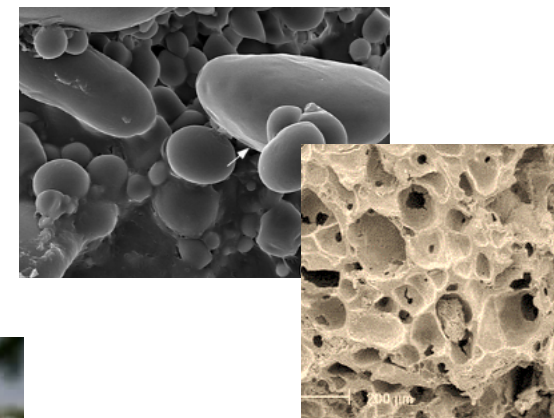
Need for renewable
raw materials



Healthy food for
healthy lives



Food reformulation



Ingredient
functionality and
food structure



Structuring plant proteins

3D PRINTING IS MATURING

HP unveils new Oregon 3D printing materials lab to be 'open for innovation'

By Benedict

HP has unveiled a new 3D Open Materials and Applications Lab at its Corvallis, Oregon site. HP's new 10,000 sq ft space will increase cross-industry collaboration, allow partners to test new 3D printing technologies, and HP Jet Fusion 3D printer, and decrease time-to-market.



Adidas to mass-produce 3D printed Futurecraft 4D shoe with Carbon's 3D printing technology

Apr 7, 2017 | By Benedict

California 3D printer manufacturer Carbon (Carbon3D) has teamed with German sportswear giant Adidas to create a new 3D printed shoe. The companies will use Carbon's Digital Light Synthesis technique to mass-produce more than 100,000 pairs of Adidas' Futurecraft 4D shoe before 2019.



General Electric invests 100 million euros into German 3D printing site

Apr 25, 2017 | By Julia

General Electric (GE) is continuing to focus its gaze squarely on the EU 3D printing industry, with a game-changing investment of 100 million euros (\$109 million USD) into a newly acquired production site in Lichtenfels, Germany.

Just last year, the multinational producer of jet engines, power plants, and other industrial equipment poured a total of \$1.3 billion into Concept Laser, a privately held German 3D printing firm, and Swedish 3D printer-manufacturer Arcam. The strategic move secured GE majority shares in both companies, cementing its position as a global leading player in additive manufacturing.



FDA approves first 3D printed prescription drug, a dissolvable tablet that treats seizures

Aug 4, 2015 | By Alec

While we've seen a lot of interesting 3D printed medical applications appear in surgery rooms already, most think about 3D printed titanium implants or plastic replicas of organs – most 3D bioprinted innovations easily take years before reaching patients. However, one New Jersey-based pharmaceutical company, **Apreece**, is hard at work pioneering another 3D printed medical application: 3D printed pills that can be taken orally. What's more, Apreece have just been awarded FDA approval for the first of 3D printed pills of its kind, the epilepsy drug Spritam.



WHY 3D PRINTING FOOD ?

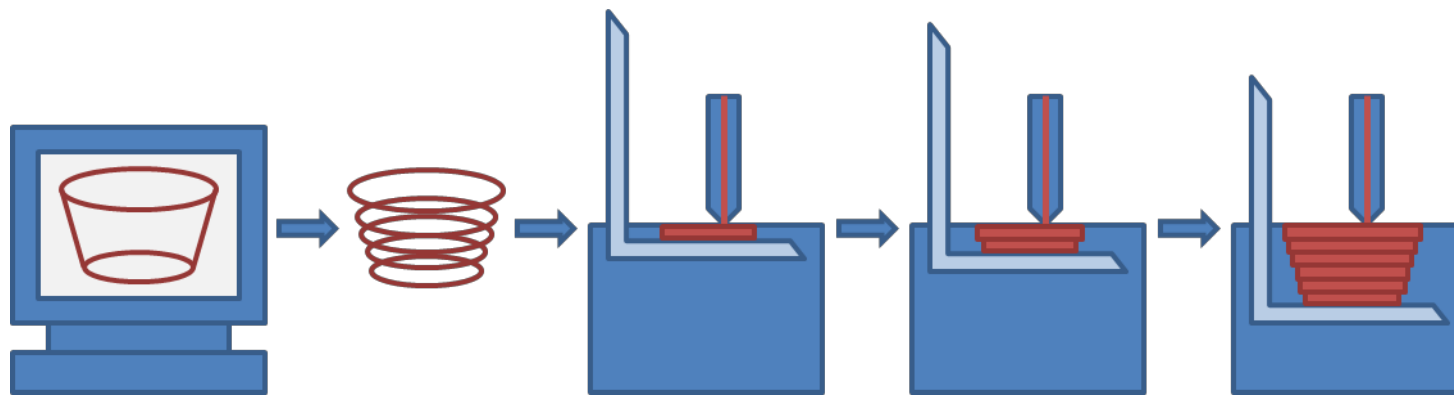


- Flexible, local, on-demand food manufacturing based on digital designs.
- Innovative food structures, functional objects that can't be made with conventional manufacturing methods.
- New opportunities for consumer interactions and empowerment by personalization.

- Sustainability, food waste reduction
- Healthy food design
- Personalized nutrition

ADDITIVE MANUFACTURING / 3D PRINTING

3D printing allows the layer-wise building of a structure directly from a 3D computer drawing using computer-controlled additive fabrication techniques without human intervention.



ADDITIVE MANUFACTURING / 3D PRINTING

- A collective term for a large number of different technologies, e.g.:



FDM



IJP



PBP

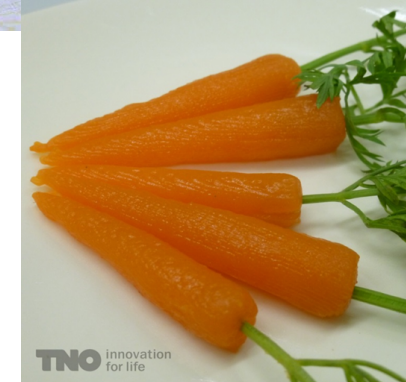
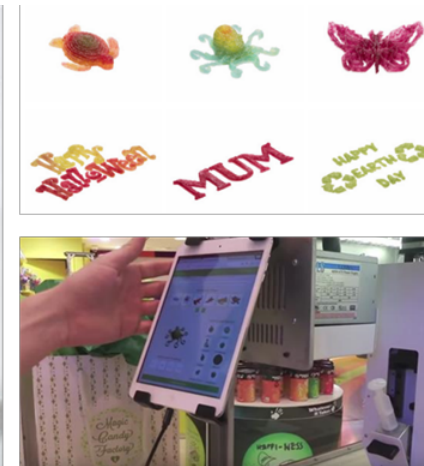


SLS

LOCAL ON-DEMAND PERSONALIZED FOOD MANUFACTURING



BluRhapsody.
eas • Shapes • Emotions

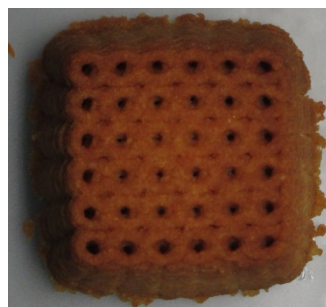
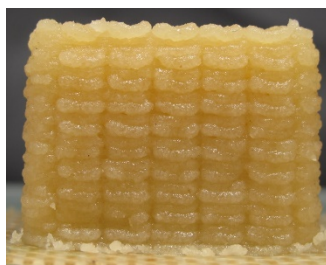
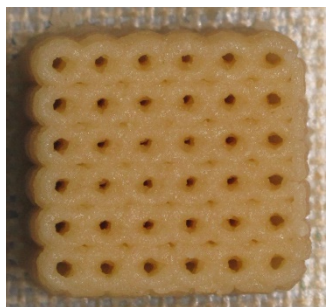


FUSED DEPOSITION MODELING (FDM)

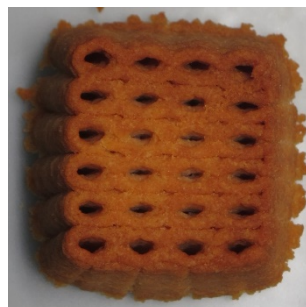
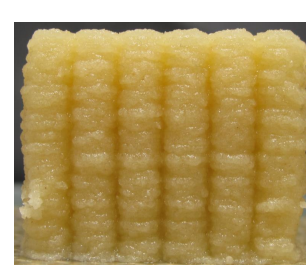
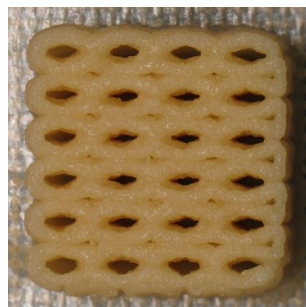


DESIGN FOAM STRUCTURES AT MM SCALE

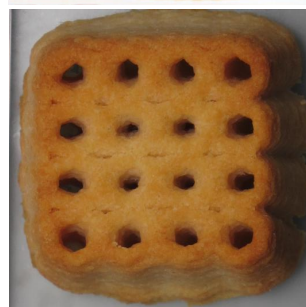
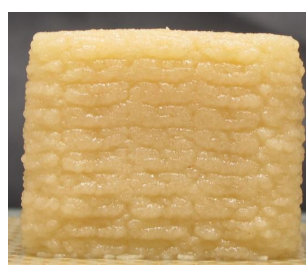
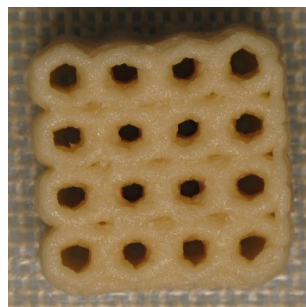
4 x 4 mm cells



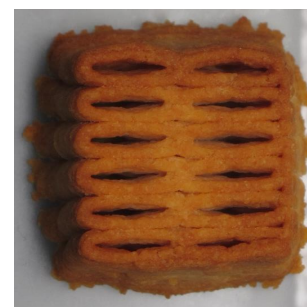
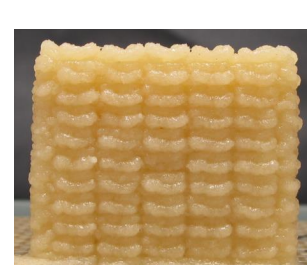
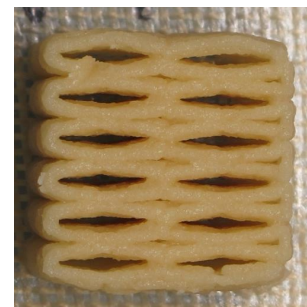
4 x 6 mm cells



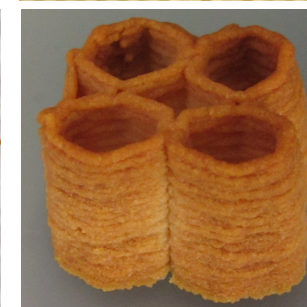
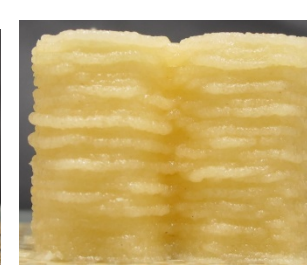
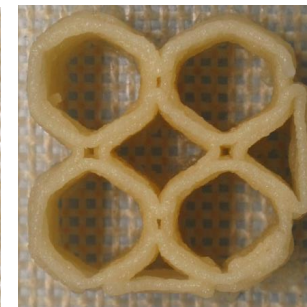
6 x 6 mm cells



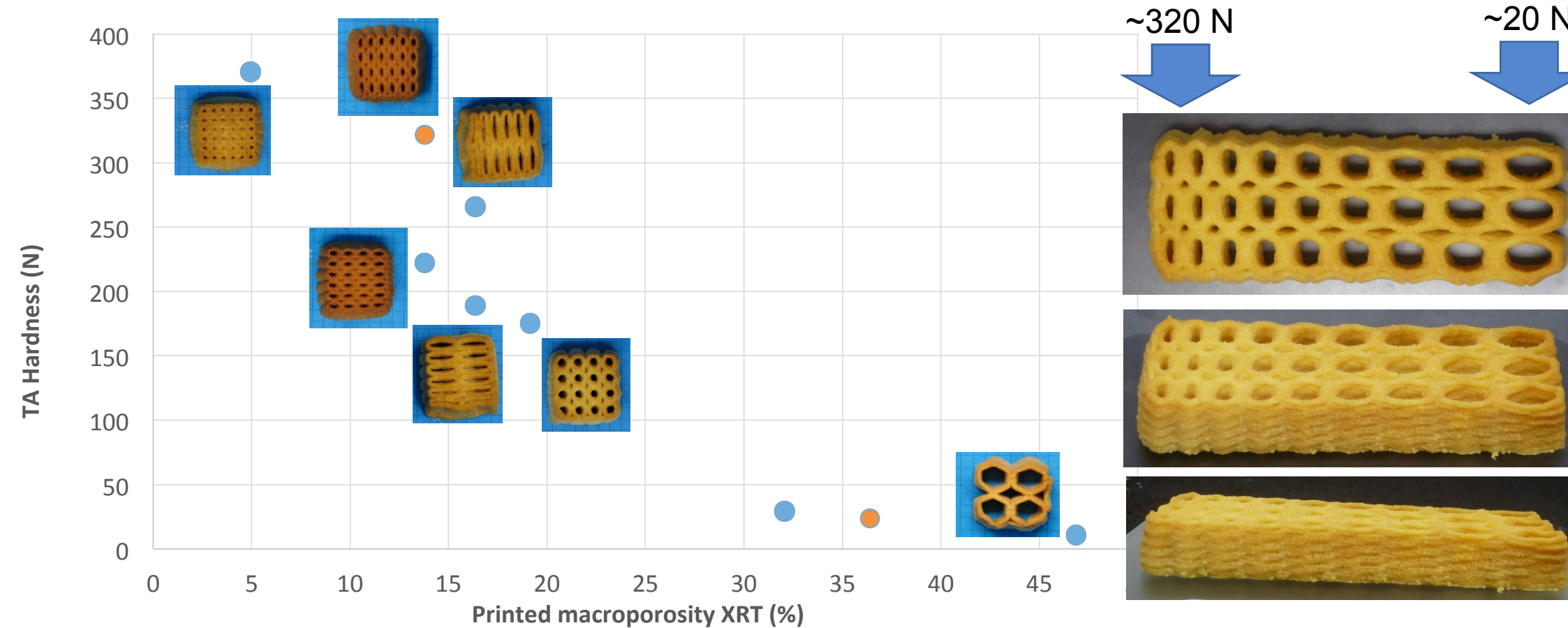
4 x 12 mm cells



12 x 12 mm cells

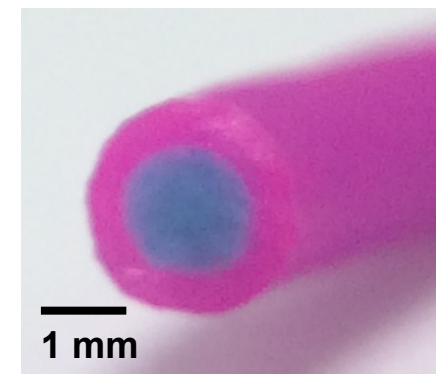
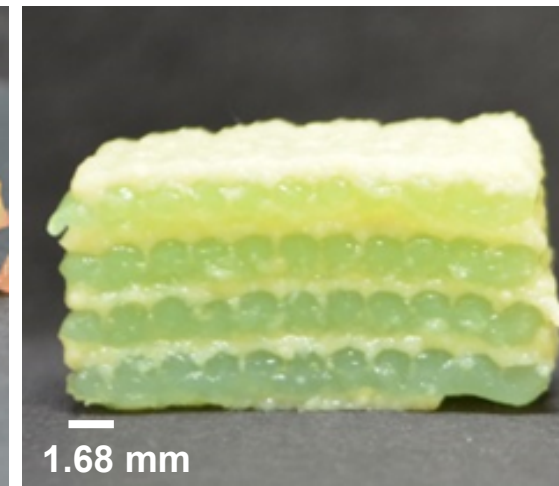
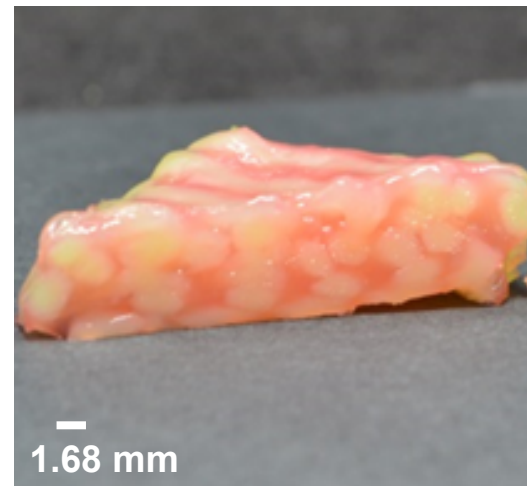


TEXTURE CAN BE VARIED BASED ON PRINT DESIGN

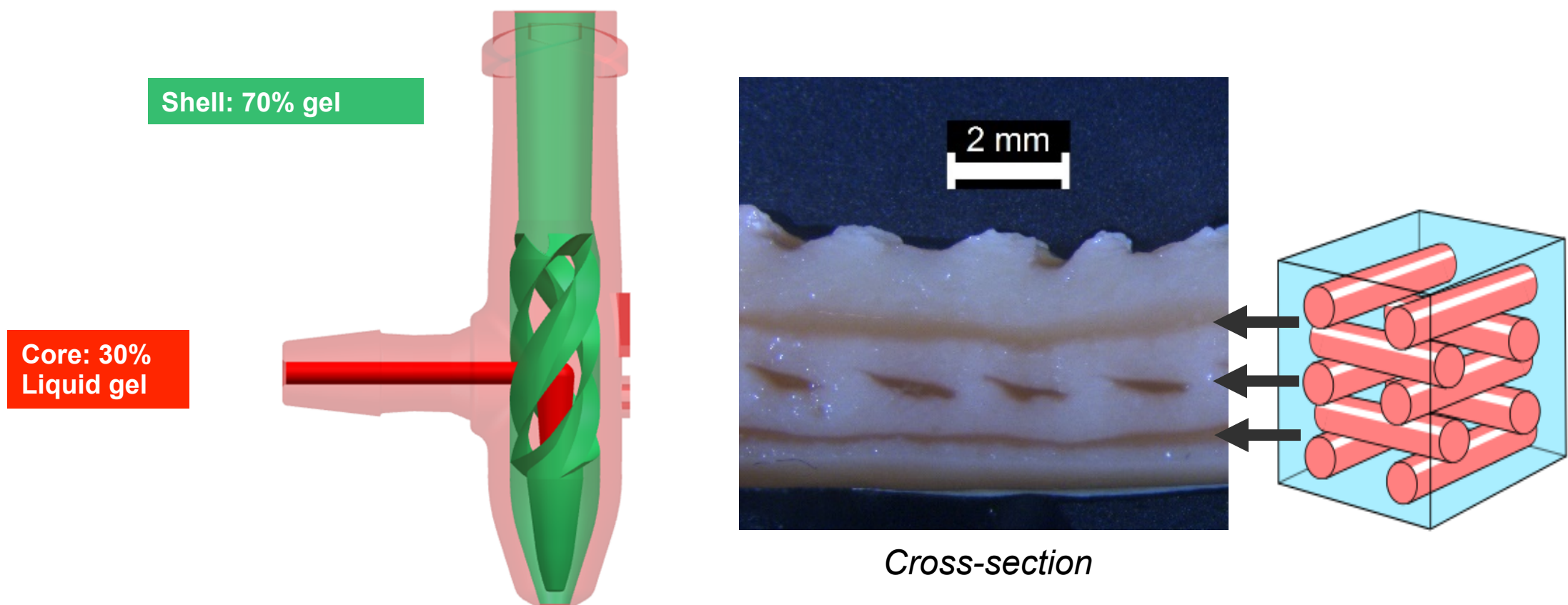


PRINTING NEW GEL TEXTURES

- Biphasic gel systems can be printed with various gel materials with different combinations of mechanical properties.
- Typically based on filament mm-scale.
- Coaxial FDM nozzle can provide filled filament at sub-mm level.



DESIGN JUICINESS: SERUM RELEASE



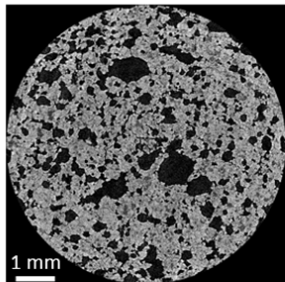
DESIGN STRUCTURES AT MULTIPLE LENGTH SCALES



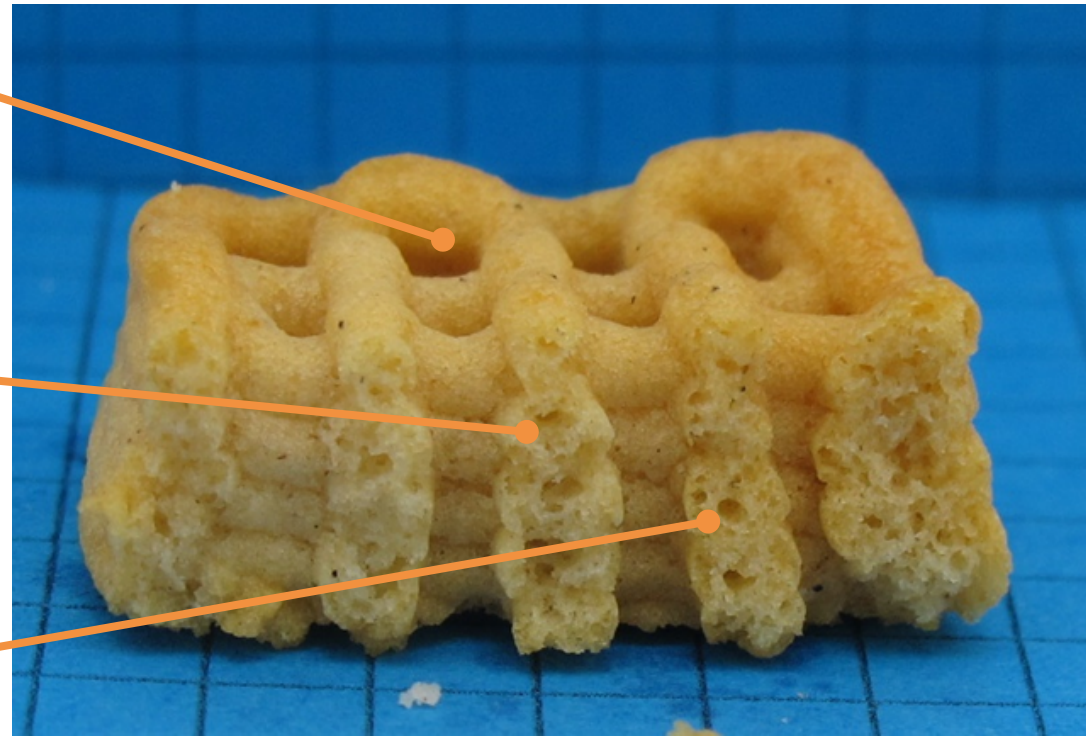
**> mm scale
printed filament /
shape design**



**100 μ m – 1 mm
achieved through
coaxial FDM**

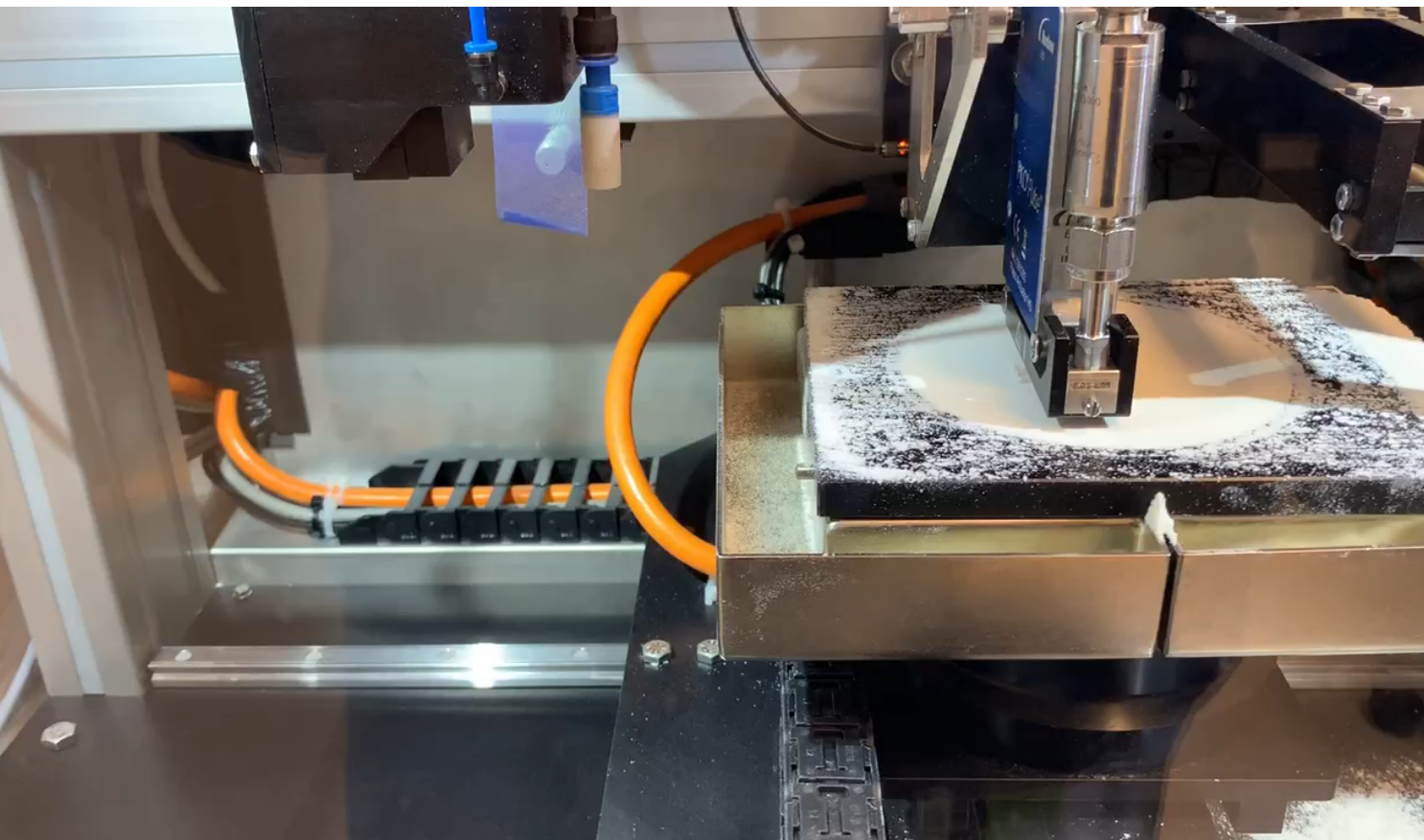


**1-100 μ m
microporosity by
dough formulation**



5 mm

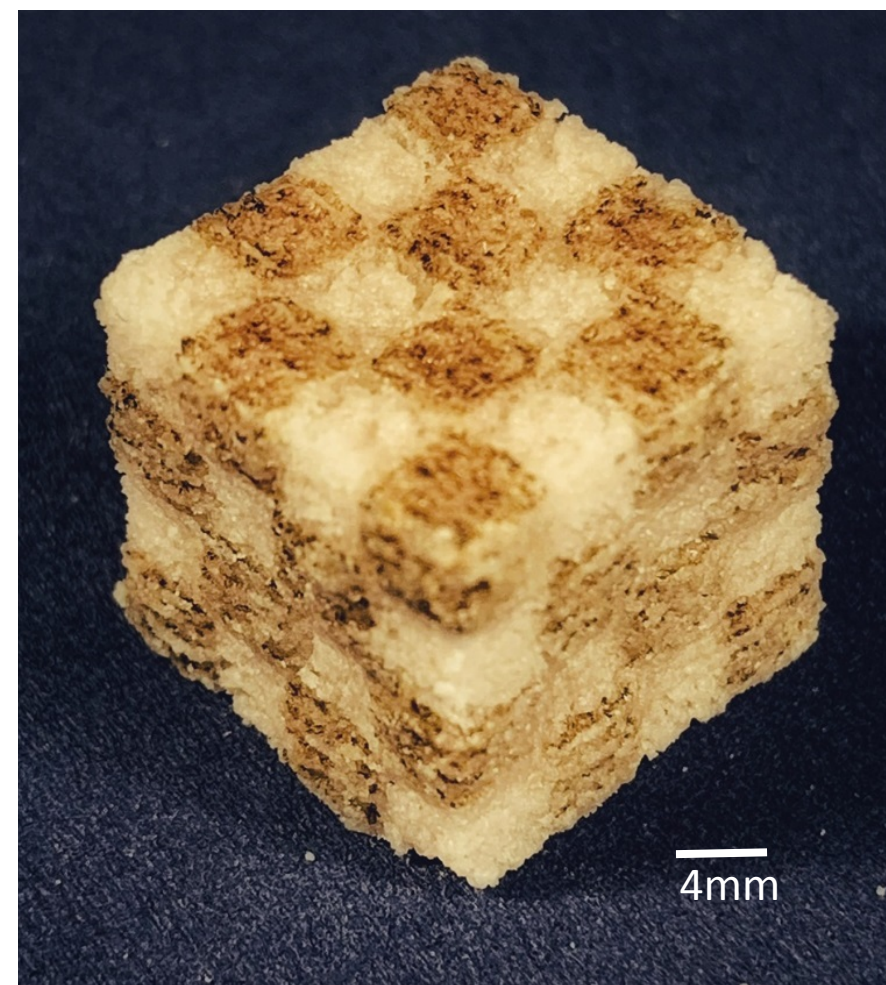
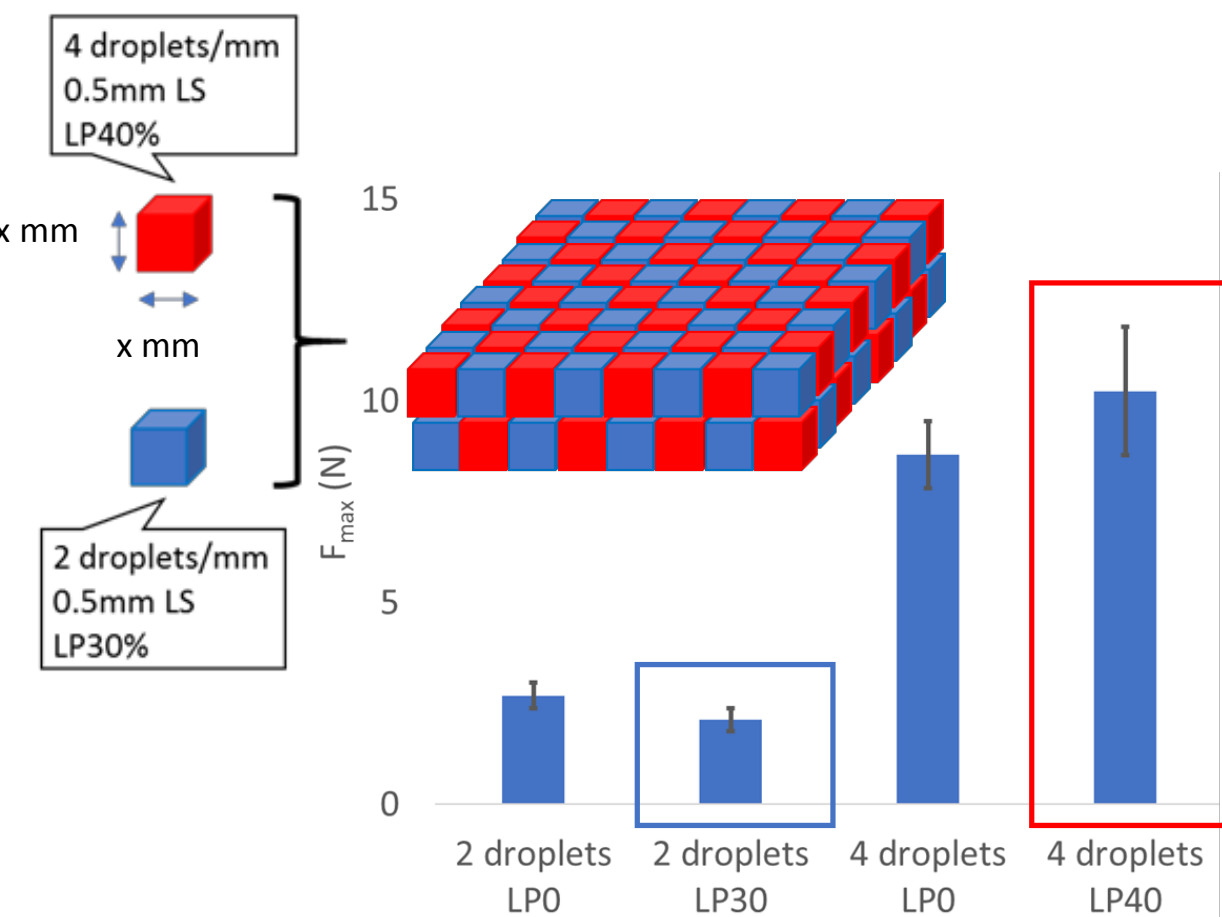
ADVANCED POWDER BED PRINTING SET-UP (PBP+SLS)



Advanced setup (PBP + SLS)

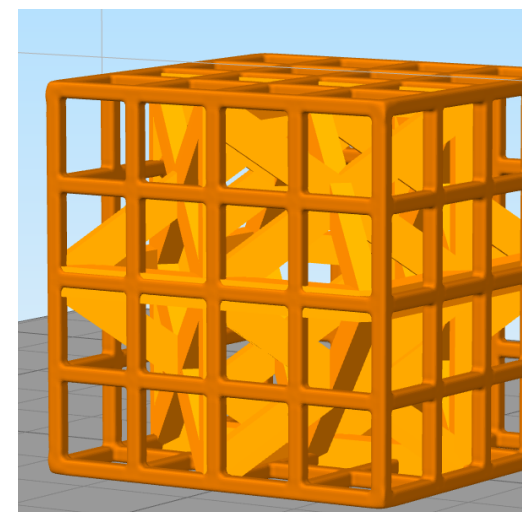
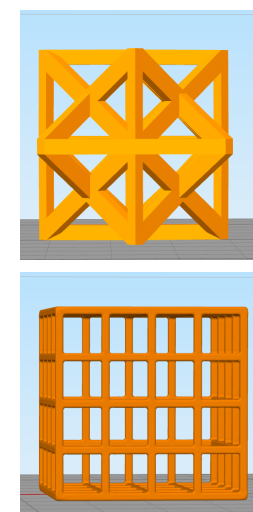
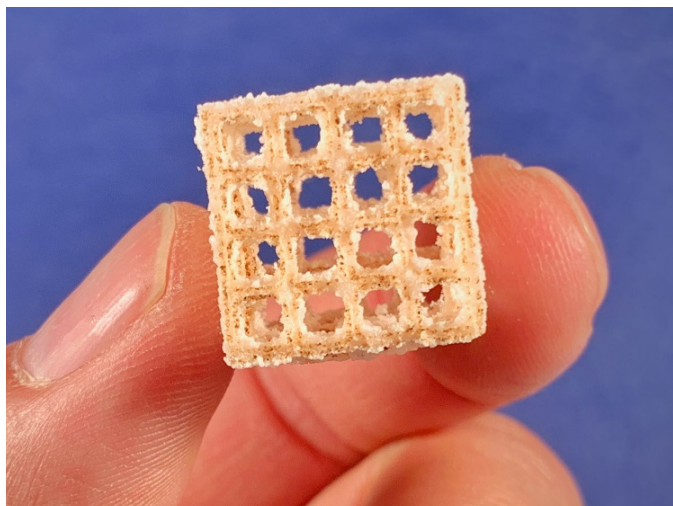
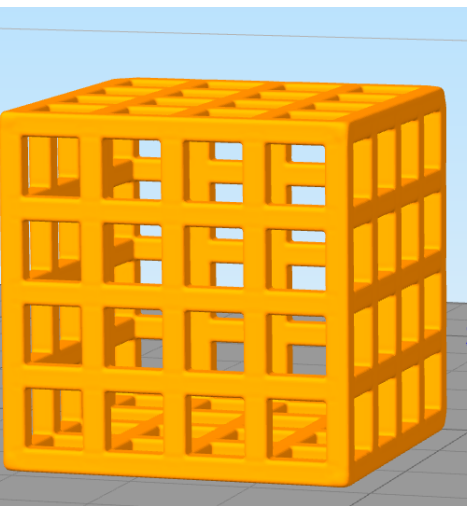
- local binding liquid deposition
- local treatment with CO₂ laser

VARIATIONS IN LOCAL TEXTURE

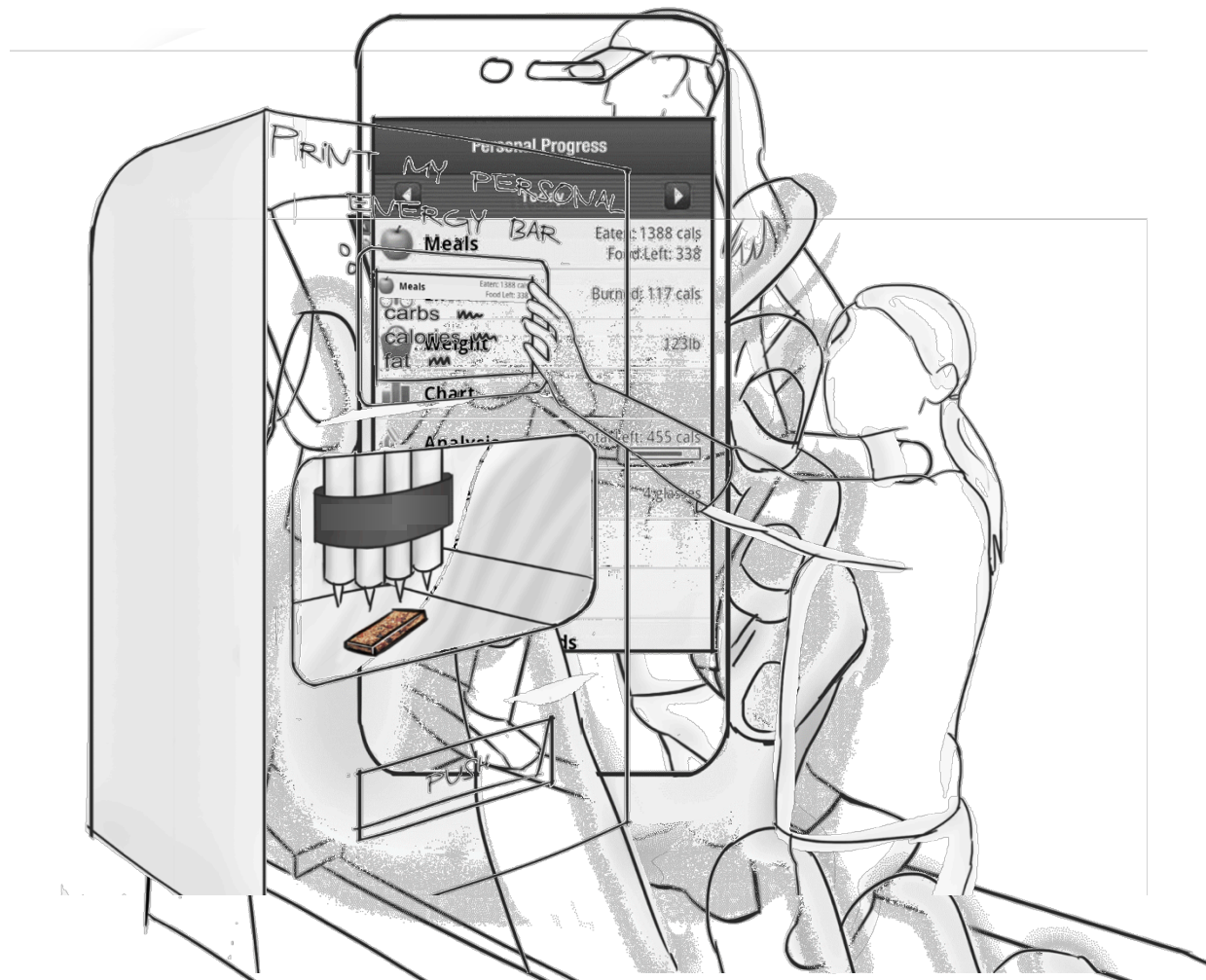


FOOD STRUCTURE ENGINEERING

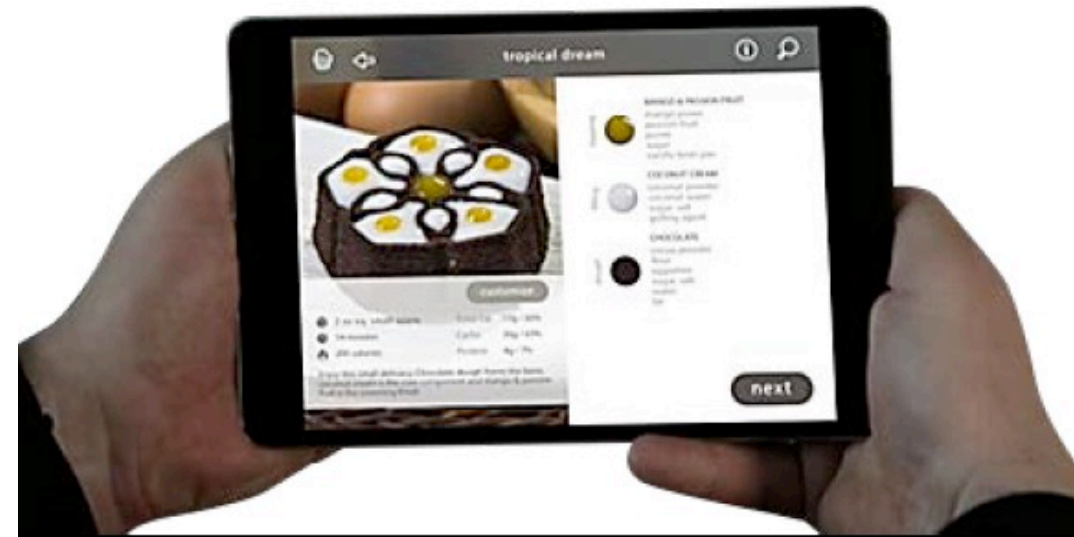
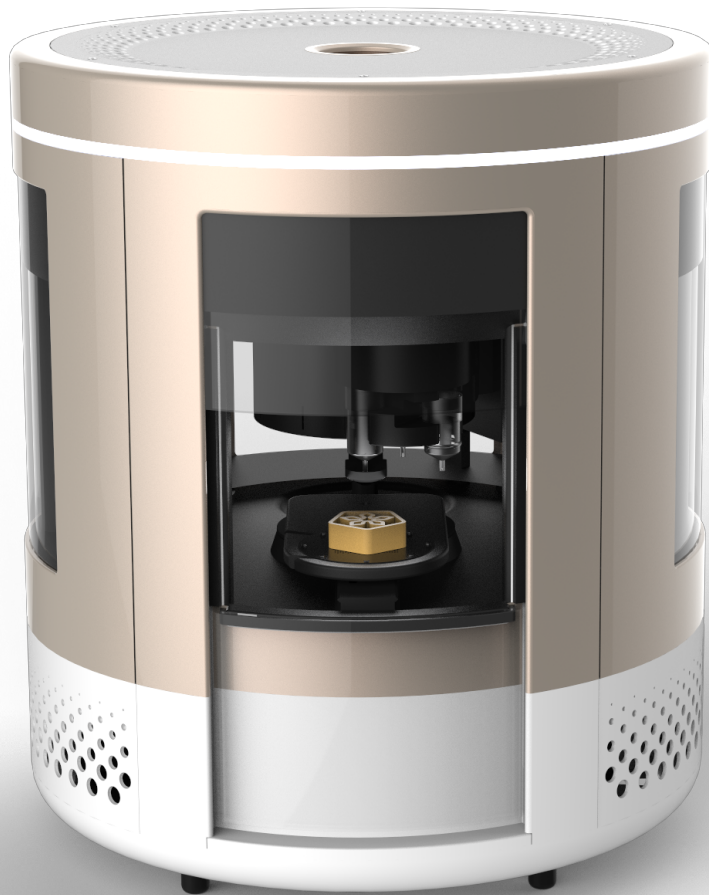
- Due to the support of the powder bed, cereal products with open structures can be printed
- Strut based lattice designs can allow us to engineer innovative cereal products with mechanical properties not possible with conventional processes



PERSONALIZED NUTRITION



BOSCH SIEMENS – PROTOTYPE

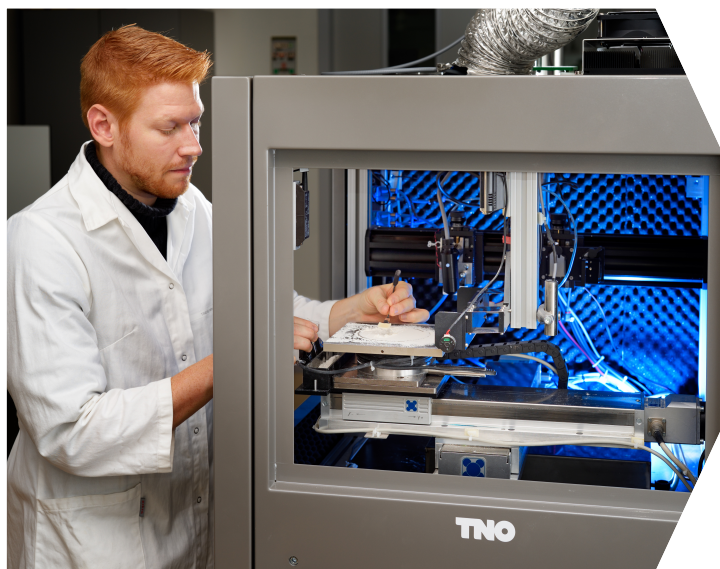


BSH HOME APPLIANCES GROUP

CONCLUSION & OUTLOOK

- Digital food processing technologies offers new opportunities to create food products with new degrees of freedom in structure, texture and composition:
 - Control **local food structure and composition** at various length scales to design its mechanical properties
 - Create **innovative food textures or functionalities**, e.g. create anisotropic textures, design fracture properties.
 - **Modulate taste perception** and sensory sensations by precise local deposition of material to control the spatial arrangements of foods.
 - Technological means to manufacture **personalized nutrition** in terms of nutrient composition, texture, taste, portion size, etc.

PLUG INTO OUR 3D PRINTING FIELD LAB



High tech equipment

Food texture and taste

Consumer preference and choice

Ingredient functionality

Healthy attractive food

Sustainable food production

Health, performance and well-being

WHAT WOULD YOU LIKE TO PRINT? LET US KNOW!

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💻 www.wur.nl/3dfoodprinting

