

MM3D FIELD LAB PROVES TECHNICAL FEASIBILITY OF MULTI-MATERIAL/MULTI-COLOUR 3D PRINTER

BREAKTHROUGH TO A PERFECT SMILE FOR EVERYONE

In three to five years' time it should be there: the multi-colour 3D printer that makes affordable artificial teeth that are indistinguishable from the real thing, ultrafast. A co-creation project within the smart industry field lab Multi Material 3D (MM3D) has demonstrated the technical feasibility of such a printer. "This is really going to make millions and millions of people around the world much happier." All that is needed is a start-up that is going to make a business out of it.

BY PIM CAMPMAN

Beautiful teeth, that's what we all want. If there's something not quite right in your mouth, it will nibble at your self-confidence. You can't be completely yourself, simply because you don't want your teeth to be the laughing stock. Artificial teeth - a set of teeth, crowns, bridges or veneers - offer a way out of that misery. Of course, the ultimate is the hand-crafted variety, and 500 euros for a crown is not exceptional. But for those who cannot pay that, 3D printed teeth are a more affordable alternative.

MUCH LOWER COST

3D printing is fast becoming a basic technology in dentistry, says Connie Peterse, Vice President and R&D Manager of NextDent in Soesterberg. This company, founded by Vertex Dental in 2012,



Tessa ten Cate (Brightlands Materials Center), René van der Meer (Océ) and Connie Peterse (NextDent): "Putting multi-material, multi-colour 3D printing technology on track, we've done that!" Photo: Océ

supplies 3D printers, printing materials (raw materials) and everything that goes with them in around eighty countries. "3D printing has really landed in the dental sector; it's used an incredible amount," says Peterse. One of the reasons for this is the cost price, which is considerably lower in comparison with hand-crafted artificial teeth. "For crowns and bridges, you're talking about a factor 10 less." Which is why this perfect smile is starting to become viable, even in low-wage countries. Not just there, by the way. "In the United States, some state hospitals measure dentures for 25 dollars. There, too, plenty of teeth are being pulled out because a crown or bridge is too expensive."

FAST AND WASTE-FREE

Another big advantage: dentists in rich countries such as the Netherlands are no longer dependent on dental technicians somewhere far away - almost always in Asia, where there are still masters of their handicraft. "Instead, they can go to a dental lab around the corner or to their own lab." At a cost no higher than the Asian route, which saves a lot of time and transport costs. A third advantage is that 3D printing does not create any waste. "A printer builds up material, while in the traditional process material is milled away: 200 grams of material is reduced to 25 grams of teeth, so you have 175 grams of waste."

But does 3D printing produce an attractive end result? Certainly, although it's not yet perfect as the two other people around the table are fully aware: Tessa ten Cate (programme manager additive manufacturing of the Brightlands Materials Center in Geleen, a joint venture between TNO and the province of Limburg) and René van

'What can be done with teeth will soon be possible with many more products'

der Meer (who has worked for Océ in Venlo for almost 29 years and who, for more than 20 of those years as senior printhead architect, has been developing control electronics, printheads and mechatronics).

MULTI-MATERIAL PRINTING

Since spring 2017, NextDent, Brightlands Materials Center and Océ have been working together in the MM3D field lab (see box), with Van der Meer in the role of project leader. They explain that real teeth are very complex, living

elements: not the same colour and structure, somewhat transparent and shiny - and slightly different in every mouth. "DNA, ethnicity and lifestyle - Do you smoke? Do you eat a lot of curry? - these are determining factors." With the current 3D printers, these features can be reproduced to a large extent - NextDent supplies material in 48 shades of white - but not yet exactly. The main reason for this is that today's 3D dental printers, like almost all conventional 3D printers, are set up for handling a single material. "Multi-material printers do exist [TNO has built a working prototype, ed.] but they are mainly used for rapid prototyping. That is, so to speak, the short way to find out whether, for example, a combination of soft and hard material - or several colours - produces something aesthetically pleasing; and if that is the case, it is produced in the conventional way," says Ten Cate. "Aspects such as strength, stability in time, resistance to UV or suitability for use in humans do not play a role in this."

THE NEXT BIG THING

But it does in the MM3D programme. It's all about the next big thing in dental 3D printing: getting a multi-material, multi-colour 3D printing technology up and running. And it is, as evidenced by the crowns that Ten Cate was able to dig up out of her bag. "Printed last week by TNO/Brightlands Materials Center on the aforementioned TNO printer." The crowns are shiny and transparent, with a hint of red that is more or less visible depending on the angle of view.

"In addition, they are mechanically very strong," she says. In the project, the three participants each contributed their specific expertise: NextDent with knowledge of dental applications and associated 3D printing materials, Brightlands Materials Center with 3D printing materials and systems. TNO has been developing this for more than twenty years and has a great deal of know-how about the laser-based stereolithography technology that is relevant to this dental case. And Océ is the specialist in full-colour copying and printing, and has a lot of knowledge to do that in 3D as well. A good example of this is the exact copy of the famous painting by Johannes Vermeer, 'Girl with a Pearl Earring', which has been widely publicised. "One of the things we have done at Océ is to customise our multi-colour software for dental applications," says Van der Meer.

MAKING PEOPLE MUCH HAPPIER

The collaboration in a field lab setting has accelerated the development of the intended solution: a multi-material 3D printer that brings a perfect smile within reach for people anywhere in the world. "And what can be done with teeth will soon be possible with many more products - all personalised," says Van der Meer. "Think of medical applications such as prostheses and insoles. You have your feet scanned and a new pair of shoes printed every two years. What we have achieved together in the field lab has the potential to really make millions and millions of people around the world much happier."



The first multi-coloured crowns to be printed in the MM3D project. Photo: Brightlands Materials Center

WHO'S TAKING OVER THE BATON?

MM3D is subsidised by the European funds ERDF and OpZuid and ends in September. Then a start-up or scale-up has to get up and take over the baton. Maybe Van der Meer will take up the challenge. "I'm writing a business plan." But the participants in the MM3D project are convinced that the multi-material printer will be available in three to five years' time. "This is not the end, but the beginning." ●

www.amsystemscenter.com/fieldlab-multi-material-3d
www.oce.com/3d-printed-dentures-may-soon-be-possible
www.nextdent.com
www.brightlandsmaterialscenter.com/am

ACCELERATE INNOVATION TOGETHER

The smart industry field lab Multi Material 3D (MM3D) focuses on three target areas in which Dutch companies and knowledge institutions can make the difference: additive manufacturing of (large) ceramic components and of integrated circuits, and multi-colour 3D printing technology for dental applications. The idea behind the field labs is that co-creation - with parties who each contribute and share their own expertise - accelerates innovation.