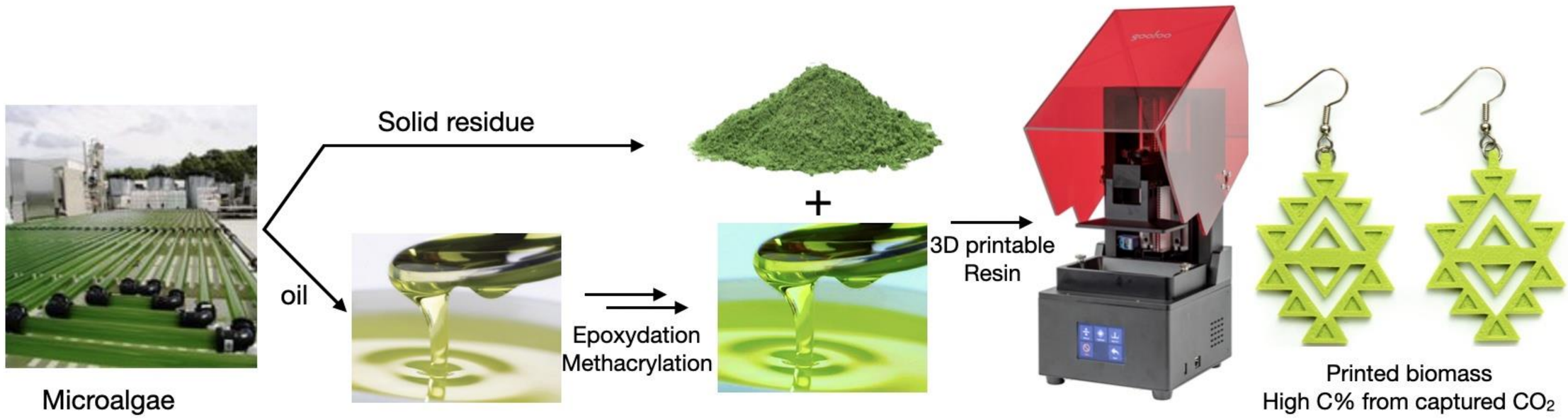
WAGENINGEN
UNIVERSITY & RESEARCH

Microalgae as SLA 3D printing material

Team involved:Vittorio Saggiomo (BNT), Antigoni Bougatsia (BNT), Maria Barbosa (BPE), Joshua Dijksman (PCC)



To which design flagship did you submit your proposal?

B: Design Flagship Proof of Principles

What are you exploring? With what objective?

In a time when the world is trying to reduce the use of plastic materials, 3D printing seems counterintuitive in terms of "green" materials. However, besides the benefit of 3D printing in general compared to the industry standard, e.g. printing only one piece, printing in place, no need for shipping, and so on, green(er) materials have started appearing on the market.
But while for FMD, they have been already developed, for example, recycled PETG or PLA, we cannot say the same for SLA printers, where the methacrylates in the resins are still coming from fossil fuel and are not recyclable. Due to the associated sustainability, we plan to use microalgae as SLA 3D printing material in this research.

Why is this interesting scientifically?

There is a great demand for 3D printable material from biomass. However, manufacturing these materials is not easy and still energy demanding. Soybean oil has already been used as starting material for SLA 3D printing. Still, soybean oil production is energy demanding, and the waste produced by the process is not usually used. Moreover, growing soybeans require arable land, competing therefore for food production This project aims to solve these problems, as the oil extraction from microalgae is more accessible than from soybean. They do not require fertile land to grow, and we will use the microalgae solid residue as filler for the 3D printing material avoiding waste generation.

How is this relevant to the materials transition?

3D printers are nowadays cheaply available everywhere. They are used for prototyping, rapid tooling, engineering, and fashion and design industry. It is part of industry 4.0 because it shifts the manufacturing from the industry directly to the end-user. This is beneficial from an environmental point of view, as the goods don't need to be shipped around the world but can be produced directly on-site. This project aims to manufacture an SLA resin made from biomass and with a high percentage of carbons from captured CO_2, helping the materials transition for phasing out fossil feedstock.

What are the key activities or steps?

- Grow microalgae that produce high concentrations of polyunsaturated oils (*Nannochloropsis sp and Tisochrysis Lutea*)
- Oil extraction and drying of the microalgae defatted biomass
- Epoxidation and methacrylation of the oils
- Resin formulation (%methacrylates + %dried microalgae + crosslinker + photoinitiator)
- 3D printed material testing with DMA (Dynamic Mechanical Analysis)
- This research will be the first stepping stone to produce SLA 3D printable materials using energy-efficient products and renewable bioresources. The final material will have a large percentage (>85%) of carbons coming from CO_2 sequestration.

What are key deliverables?

M1/D1 Successful production of methacrylates from microalgae oils.
M2 Study on the resin formulation and amount of microalgae filler that can be 3D printed
D2 3D printing material from microalgae (TRL3/4)
D3 DMA analysis of the printed materials

One what issues would you like to get input from others?

Economic / legislation for biobased material.
What's a fair price compared to non-biobased material?

Wageningen University & Research
P.O. Box 123, 6700 AB Wageningen
Contact: vittorio.saggiomo@wur.nl
@V_Saggiomo
www.wur.eu/bnt