3D-Manufacturing of Novel Biomaterials (3D-BioMat)

Industrial biorefineries are in great role in implementing national bioeconomy. The grand challenge in biorefining is the full utilization of biomass into high value-added products. Our main goals are new material concepts and production value chains by combining novel biomaterials with the fast-developing 3D-additive manufacturing technologies. This far multiple strategies have been utilized regarding both material research and additive manufacturing. Innovations include:

1) **Novel UV-paste extrusion of a biocomposite resins including cellulose**

   A novel biocomposite resin with a cellulose content of nearly 30 vol% was successfully fabricated and 3D printed by using an in-house developed extruder system with attached UV lights. The method is suitable for fabrication of complex large–scale components produced by extrusion of a resin with a low degree translucency.

2) **Two-component material mixing and extrusion systems**

   A 6-axis robot was fitted with a two-component material extruder that takes quick curing epoxy resin as the base material. Next step in the project is to optimize the printing parameters for creating 3D objects utilizing two-component epoxy resins mixed with bio-fillers (lignin, fumed silica etc. for example).

3) **Nanocellulose based emulsions for cell culturing applications.**

   Another interesting research topic is the development of nanocellulose-based emulsions and gels for additive manufacturing. These products may have potential, for drug release and cell culturing applications. Two different approaches have been applied to fabricate conductive, elastic, bio-based composites of which one can be seen in Figure 1.

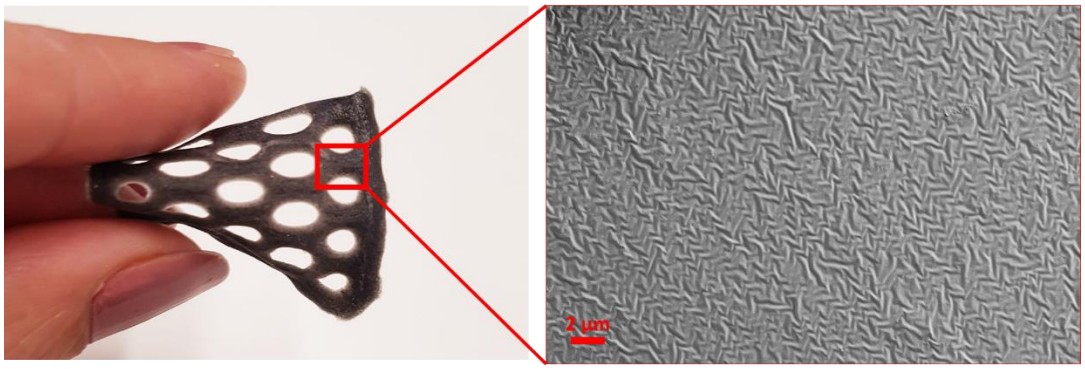

Figure 1. *3D printed conductive, elastic, bio-based composite (left) and the microstructure by scanning electron microscope (right).*

The promising results of these approaches have encouraged us to find new applications and to optimize the manufacturing of the designed materials. The project will continue to study different biomaterials and how they can be applied in 3D printing in the form of gels, emulsions and composites for various customizable applications.

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