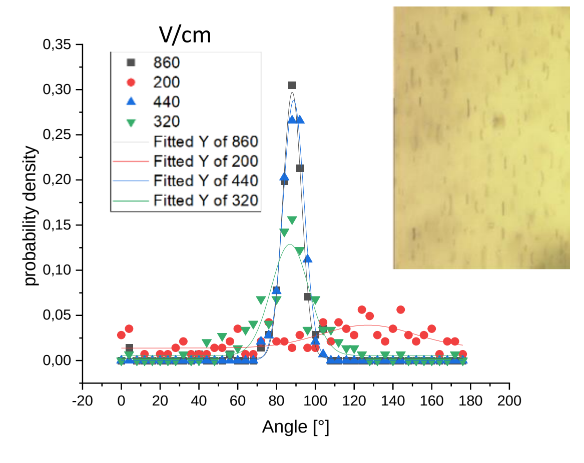
TECHNOLOGY OFFER

In-situ alignment of dielectric fibers using electric fields in extrusion processes

Precise control of fiber orientation in composites is critical to the mechanical, electrical, optical, and biological properties of many materials. Our technology enables in-situ alignment of dielectric micro- and nanofibers during extrusion of any type of non-conductive polymer matrix. Fiber alignment is possible in all three spatial dimensions, it can be dynamically changed during extrusion, and it can be used to produce 3D objects with unprecedented and enhanced anisotropic properties.

BACKGROUND

The superior specific mechanical strength and toughness of naturally evolved composites originates from precise orientation of reinforcing fibers or particles in a matrix. While living organisms grow these anisotropic reinforcement architectures out of themselves, fiber alignment in polymer processing and especially in 3D printing requires external forces such as shear force or magnetic fields. Moreover, it is often limited to specific application scenarios. In contrast, strong electric fields could control the alignment of a wide range of different dielectric fiber materials. This will lead to novel mechanical, electrical, optical and biological properties.



TECHNOLOGY

Herein we provide a technology that allows for the targeted orientation of fibers in polymer melts, solutions or gels during an extrusion or a 3D printing process. This is achieved by specially designed extrusion nozzles containing multiple electrodes and a control over electric fields in these nozzles. It is combined with fiber alignment due to the extrusion shear forces. The alignment direction can further be changed and controlled during the continuous extrusion process, allowing for a precise fabrication of anisotropic 3D printed objects with novel mechanical, electrical, optical and biological properties.

ADVANTAGES

Our technology has several advantages and new potential applications:

- Wide material spectrum e.g., natural fibers (cellulose, chitin,…) and synthetic fibers (PTFE, carbon nanotubes, metals, ceramics,…).
- Easy integration into existing extrusion devices.
- Precise control of fiber orientation in every spatial dimension.
- Change of fiber alignment within a continuous extrusion e.g., corners in 3D printing.
- Enhanced or new material properties e.g., local control of mechanical strength or electrical conductivity.

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KEYWORDS:
- Electric Fields
- Extrusion
- Dielectric Material
- Anisotropic Solids

INVENTORS:
- Florian Lackner
- Karin Stana Kleinschek
- Rupert Kargl

COOPERATION OPTIONS:
- Licensing
- Sale
- Technical Cooperation

DEVELOPMENT STATUS:
- Proof of Concept

STATUS OF PATENTS:
- EP Application Filed

CONTACT:

Alexander Muhr
Graz University of Technology
Research & Technology House
Mandellstraße 9/11
8010 Graz
T: +43-(0)316-873 6924
alexander.muhr@tugraz.at
www.tugraz.at/go/ft-haus