BIOPOLYCOMP – Biochar for Polymer Composites

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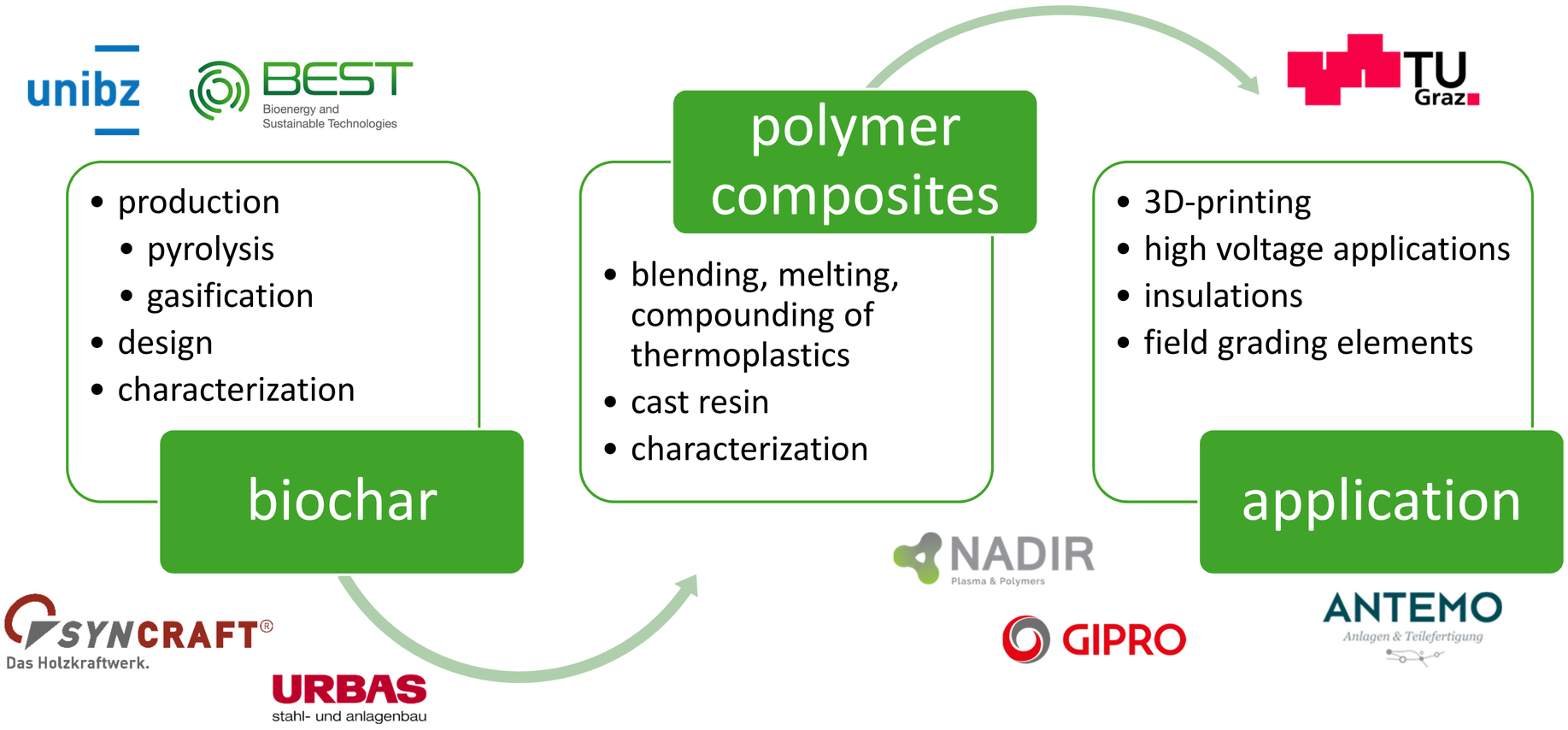
Thermochemical Technologies
Process Analysis and Simulation



Background

Char originating from biomass can be used as a sustainable carbon additive in the production of polymer compounds with enhanced characteristics.

The advantages are manifold:

- improvement of the mechanical, thermal and dielectric properties of the composites
- reduction of the CO_2-footprint of the composite production
- Improvement of the overall plant economy by utilizing organic residues, e.g. from biomass gasification-based CHP-plants

Biochar differs considerably depending on its origin. Indeed, initial feedstock, conversion technology, reactive agents and operating conditions strongly affect the final characteristics of the char and subsequently of the final composite product.

The project

Chars of different origin are sampled and analysed. Threshold values such as moisture content, volatile content, maximum particle size, enabling subsequent polymer compounding processes are identified. Char parameters like ash content, fixed carbon, elemental composition, particle density, particle size distribution, specific surface area, pore size distributions, structural constitution via Raman spectroscopy (**Fig.1**) and dielectric properties are determined to investigate possible correlations to polymer composite properties.

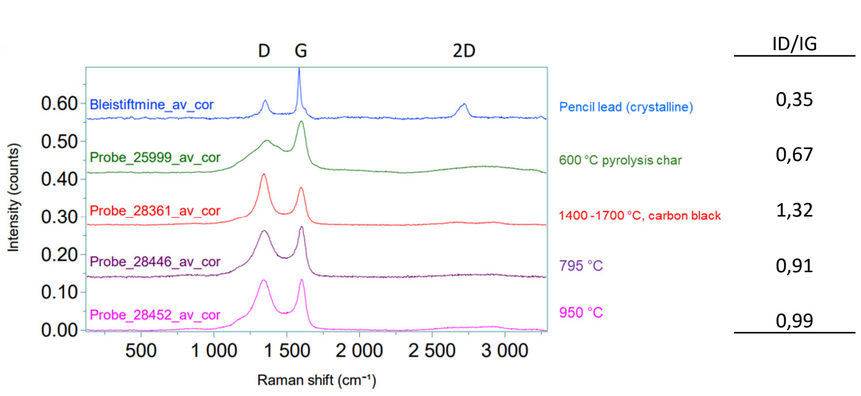


Fig.1 : Raman spectra of chars produced under different temperature conditions and carbon black; the intensity ratio of D-peak and G-peak (ID/IG) is an indicator for the share of crystallinity.

During the subsequent compounding process char is blended with various thermoplastic polymers resulting in different char-polymer composites (**Fig.2**). These polymer composite samples are characterized regarding their applicability for specific assignments. Two fields of application are targeted: 1) production of char-polymer composites with adequate mechanical and thermal properties for 3D-printing applications and 2) functionalized utilisation in high voltage (HV) technology as a semiconducting dielectric or a dielectric with high permittivity for targeted field grading in HV-cables and cast-resin isolators.

Tests showed that the good processability of char as polymer additive producing filaments for 3D-printing can be achieved, adhering boundary conditions, e.g., regarding the char properties, such as content of volatiles, particle size, and limits of char to polymer ratios.

Fig.2 : Compounding tests, production of composite filaments and samples of 3D-printed polymer composites .

Manufactured polymer composite samples (BPC) have been analysed on their dielectric properties (**Fig. 3**). They showed comparable behaviour to fossil-based carbon sources, such as carbon black, employed as reference additive.

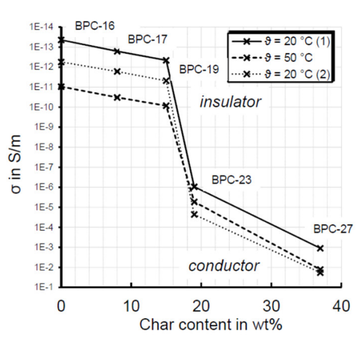


Fig.3 : Resistivity of composite sample over char content.

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Fig.4 : BIOPOLYCOMP-Stakeholder-workshop at the CEBC 2023; project partners

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