Name: Diogo Manuel Amaral Santos Costa

Name of the project: **Highly porous materials of cellulose from agricultural residues**

Abstract of the project:

The plants, Hemp and flax are cultivated mainly for fiber production due to their outstanding durability, absorbency, anti-microbial activity, among others. Canada, one of the world's larger producers of hemp, has more than 70000 acres of industrial hemp for fiber and seed (oil and cake) production however the market value of the fibers is too variable (50-500$ per ton, depending of its quality) to assure farmers a stable income.

This project, which will be conducted between DLR (Institute of Materials Research, in Cologne, Germany) and the KEEY Aerogel company (Mulhouse, France) will focus on the conversion of these biomass residues into aerogels for application as thermal insulators. The first phase will be mainly developed at DLR´s site and will consist of the characterization of both flax and hemp fibers and their conversion into aerogels, both in the form of beads and sheets. These products will be characterized and the synthetic methods will be optimized in order to obtain valuable materials with the desired properties. A preliminary up-scaling of the production will also occur by using jet cutter technology for beads and CA-production line (CA-ProLi) for sheets.

After optimizing the synthetic routes, which shall take the first half of the PhD, the upscaling of the aerogels production from 1L up to 170L will be developed at KEEY Aerogel. This company has a valuable expertise in CO_2 supercritical technology ($scCO_2$) and infusion techniques of silica (from waste-SICLA^{TM}) that should be valuable in the formation of functionalized aerogels with minimal volume shrinkage during their drying.

In conclusion, the project predicts that in 3 years it will be possible to create bio-based aerogels from biomass residues, that will be industrially produced in a continuous fashion.

Introduction of the ESR:

My name is Diogo Costa and I come from Sesimbra, a small fishing village in Portugal. I did my Bachelor studies in Applied Chemistry, in Lisbon NOVA University. There, I found out my passion for the bioeconomy and the valorization of biomass. After I finished my Bachelor thesis about the pyrolysis of used cooking oils for fuel production, I decided to continue my studies in Institute Superior Técnico, Lisbon University, where I got my Master degree in Chemistry. My Master thesis, developed in Strasbourg University under the Erasmus agreement, focused on the development of biochar from hyperaccumulator plants to act as catalysts in the conversion of methane to hydrogen.

For the past years, my work has been focused in the conversion of biomass residues into high-valuable products and compounds in order to promote the materialization of the biorefinery concept. It is under that banner that I am a proud PhD candidate of the Biobased Value Circle Consortium. Besides studying

agricultural waste, my main interests and hobbies include reading, foot orienteering, traveling and text narration.

Keywords:

Lignocellulose; Aerogel; Biomass; Thermal Insulator; Bio economy; Flax; Hemp; Supercritical CO_2; Industrial Production

Contact details:

- Name: Diogo Manuel Amaral Santos Costa
- Department/University/Company:
  Department/University:
  Department of Aerogels and Aerogel Composites, Institute of Materials Research, German Aerospace Center (DLR) and
  University of Cologne (UoC), Department of Chemistry, Nanostructured Cellular Materials
  Company: KEEY Aerogels
- Address Department/University/Company
  DLR: Linder Höhe, 51147 Köln, Germany
  UcO: Greinstraße 6, 50939 Cologne, Germany
  KEEY Aerogels: 203 Rue du General de Gaulle, 68440 Habsheim, France
- Phone: +49 2203 601 1134
- Email: diogo.costa@dlr.de