Biochar is a material produced from the thermochemical processing of wood biomass. Besides presenting remarkable properties, this material is a tool for the sequestration of CO₂. Unfortunately, biochar has been mainly employed in low value-added fields, such as in pollutant removal and in soil amendment. The diversification of biochar applications is an approach aligned with the Green Chemistry principles and can further address our current environmental challenges. The use of a material obtained from waste with recognized carbon sink potential can reduce impacts of consumption, contribute to our good health and well-being, and also mitigate climate change.

In this presentation, we will discuss strategies pursued in the areas of CO₂ transformation, nanomaterials, polymer composites, catalysis, and their respective applications in biochar research. We have shown that functionalized biochar can facilitate the cycloaddition reaction between epoxides and CO₂ under relatively mild conditions to produce cyclic carbonates. The catalytic system proposed possesses good recyclability and wide substrate scope. We have also investigated the production of biochar nanostructures via a process known as Liquid-Phase Exfoliation (LPE). LPE is a scalable exfoliation technique to produce nanostructures of layered materials, but has only been applied to biochar using toxic solvents. By employing safer alternatives, biochar and its functionalized analogue could be processed in solvents such as acetone, ethyl acetate, dimethyl carbonate, and polyethylene glycols. The exfoliated materials produced could be further applied as sustainable additives in the synthesis of biodegradable polymers. Polycaprolactone composites with improved stiffness, crystallinity, and potentially higher levels of degradation could be obtained with small additions (i.e. 0.1-5.0 wt%) of exfoliated biochar. Lastly, the investigation of functionalized biochar as a catalyst for the synthesis of O-heterocycles, compounds with wide applications in the chemical industry, will be discussed.

References