Sustainable Transformation of Brewed Coffee and Tea Grounds to Useful Mesoporous Carbon Membranes

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Coffee and tea are the two most common beverages in the world. Generally coffee is made from beans, while tea is from leaves. Every year, the tremendous amount of used coffee grounds and tea leaves are being thrown away after use. In this project, I have developed a sustainable method to transform used coffee and tea grounds to a more valuable material: mesoporous carbon membrane. The used coffee (or tea) grounds were mixed with 7M KOH solution and then the mixture was heated at 65 °C to remove water (solvent). The resulting viscous solution was annealed at 700 °C under an argon atmosphere. After this process, mesoporous carbon (powder) was obtained. This carbon powder was mixed with the ethanolic solution of polymeric resin in order to cast films on a quartz substrate. The pyrolysis of casted films was made under an argon atmosphere to prepare mesoporous carbon membranes. Although the natures (beans vs. leaves) of coffee and tea are different from one another, the physical properties (e.g., surface area, average pore size, and pore volume) of mesoporous carbon membranes made from coffee and tea are quite similar. For a potential application, I created a prototype ion gate using this membrane, with which the diffusions of cations and anions are selectively controlled by applying electric potential to the membrane. The ions used in this work are methylene blue (cation) and methyl orange (anion). When a positive potential was applied to the membrane, methyl orange freely passed through the membrane by diffusion but methylene blue did not. The opposite effect was observed when a negative potential was applied. For future research, I intend to test more cations and anions to utilize this ion gate for the removal of toxic ions in water.

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