Preparation of CO_2 sorption pallets from polyaniline using microwave heating

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The porous nitrogen-doped carbons (N—C) have been intensively studied and exploited in various applications such as gas sorption and separation, energy storage, catalysis, etc (1). The common synthesis procedure for the N—C is based on the annealing treatment of carbon precursor at a high temperature (>500 °C) for a long period (from one to tens of hours). The energy consumption of 170–200 kWh is roughly estimated for the preparation of 1 ton of N—C resulting in the emission of 127.5–150 kg of CO_2 (2). The entire synthesis procedure of the N—C has a negative environmental impact. Therefore, employing alternative energy sources such as microwave irradiation can reduce energy usage and ensure a more environmentally sustainable and economically viable synthesis approach for the widely applicable materials such as N—C. This procedure requires the use of non-transparent materials to electromagnetic waves that can convert microwave energy into heat and simultaneously enable the carbonization of the starting material (2). In this work, we compared the preparation of the N—C derived from polyaniline (PANI) using thermal and microwave heating and tested the properties of these materials as a CO_2 sorbent. Detailed analysis of the prepared materials confirmed possibility of the preparation of PANI pallets with a mass of hundreds of grams by the simple approach of vacuum filtration. The successful production of N—C from PANI was achieved using microwave carbonization as a simplified approach with a low energy utilization and exceptionally rapid processing times. The material prepared by microwave heating showed similar properties to the thermal one in terms of morphology, chemical composition and CO_2 sorption capacity suggesting its substitution.

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References

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