

Development of Highly Porous Activated Carbon by Pressurized Physical Activation Based on the Microdomain Pore Structure Model

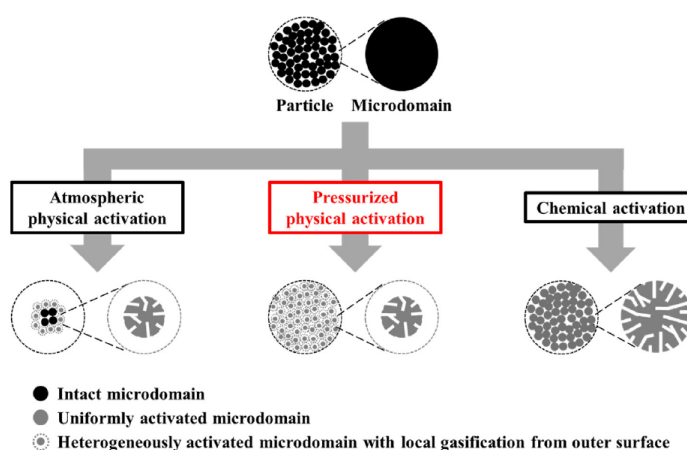
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Porous carbon materials are widely used in various application fields, such as gas purification/separation/storage, water-treatment, solvent recovery, catalyst support, and electric double layer capacitor. Growing demand for the high-performance porous carbon materials stimulates developments of new production and tuning techniques. Activated carbon (AC), one of representative porous carbon materials, is also desired to improve the physicochemical properties, especially the porosity, for upgrading the application characteristics and expanding the application fields. To produce AC, activation is a key process, because it governs the porosity.

In this talk, a simple production method of AC with a highly developed pore structure is introduced [1]. An idea of the “pressurized physical activation” was come up with an understanding of pore development mechanism for physical and chemical activations based on a recognition of microdomain, which is a basic structure unit of artificial carbon materials [2]. This pressurized physical activation method can afford AC with a specific surface area larger than 2600 m²/g, which is difficult to achieve by a conventional atmospheric pressure physical activation: The pressurization improved the diffusivity of activating gas in carbon particles, giving rise to developments of both intra-microdomain pores for most of microdomains consisting of carbon particles and inter-microdomain pores (**Fig. 1**). Although chemical activation method produces AC with superior degree of pore development and activation yield, the pressurized physical activation method is considered as an option to provide a high degree of pore development at a relatively low-cost way. Together with the high porosity, the pressurized physical AC showed a characteristic pore size distribution and a high bulk density. Taking these advantages, a potential of the pressurized physical AC was demonstrated as a high-performance adsorbent in adsorption heat pump system using ethanol as a refrigerant [3].



References

- [1] *Carbon*, **183**, 735–742 (2021).
- [2] *Carbon*, **114**, 98–105 (2017).
- [3] *RSC Adv.*, **12**, 2558–2563 (2022).

Figure 1. Schematic diagram of differences in atmospheric pressure physical, pressurized physical, and chemical activation processes [1]