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Formation of well-defined spherical porous carbon particles transition from dense to hollow structure derived from Kraft lignin

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In recent years, the rational synthesis of carbon particles with precisely tailored shapes and structures from biomass as a raw material would be highly beneficial with regard to sustainable development goals. The present work generated spherical carbon particles based on spray drying method followed by the carbonization process, using Kraft lignin as the carbon source and potassium hydroxide (KOH) as the activation agent. As the results, the proposed method successfully controlled the structure and shape of the carbon particles from dense to hollow simply by adjusting the KOH concentration for the first time [1]. In addition, to obtain an in-depth understanding of the particle formation of carbon particles, a possible mechanism is also investigated in this research. Furthermore, the high specific surface area (2424.8 m^2 g^{-1}) with micro-mesoporous structure of hollow carbon spheres (HCSs) were obtained at a low KOH-to-lignin mass ratio (below 1.5), which was in accordance with green chemistry principles. These HCSs have applications as electrode materials in supercapacitors for energy storage devices [2]. With the great achievements and continuous efforts in this important field, these results suggest that our approach adopted herein will open up opportunities for the development of advanced carbon materials and high value-added utilization of Kraft lignin as a promising material for potential applications.

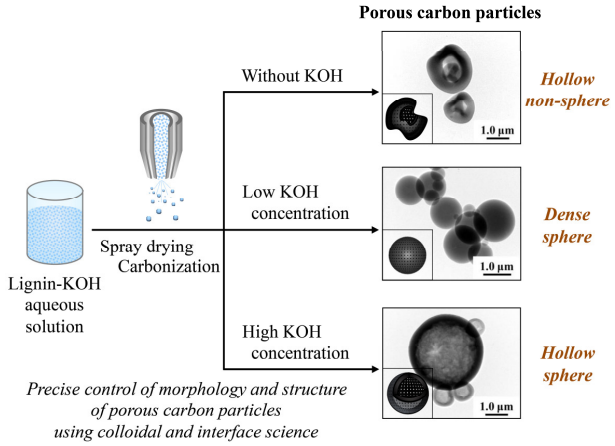

Fig. 1. Schematic illustration for the synthesis of porous carbon particles with controllable morphology and structure.

References:

[1] K.L.A. Cao, A.M. Rahmatika, Y. Kitamoto, M.T.T. Nguyen, T. Ogi, J. Colloid Interface Sci. 589 (2021) 252–263.

[2] K.L.A. Cao, Y. Kitamoto, F. Iskandar, T. Ogi, Adv. Powder Technol. (2021), in press.