Hydrolysis Controlled Synthesis of High-surface-area Mesoporous Alumina Powders

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High-surface-area alumina has been widely utilized as catalyst supports and then we have challenged to synthesize a variety of mesoporous alumina powders.[1,2] However, it has been occasionally difficult to reproduce similar mesoporous alumina powders showing outstanding specific surface area more than 500 m^2 g^{-1}. In this study, a series of mesoporous alumina powders were synthesized using amphiphilic organic molecules (e.g., Pluronic P123) by a spray-drying method. Although our original synthesis was conducted by using ethanol (EtOH) as a solvent,[1] 1-BuOH and 2-BuOH were mixed with EtOH as the main solvent to suppress the formation of highly reactive aluminum ethoxide originating from starting chemicals such as aluminum butoxides. Such a hydrolysis process was traced by UV-Vis and the quality of the mesoporous structure was mainly evaluated by using XRD with N_2 adsorption-desorption measurements. The specific surface area was improved by controlling the hydrolysis process of aluminum sources like aluminum *sec*-butoxide in alcoholic solvents such as EtOH and 2-butanol. As shown in Figure 1, a 20 vol% substitution to 1-BuOH allowed us to obtain mesoporous alumina powders showing a specific surface area (504 m^2 g^{-1}) higher than that obtained from the original precursor solution (100 vol% EtOH; 439 m^2 g^{-1}).

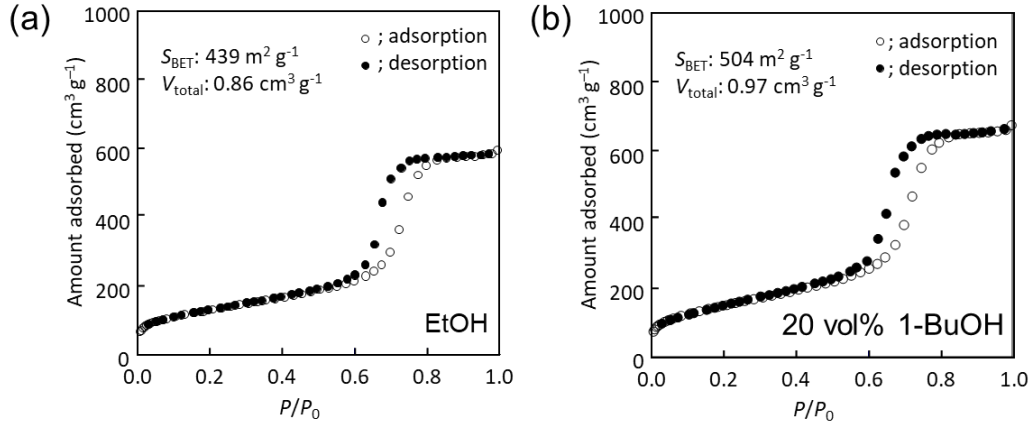

Figure 1. N_2 adsorption-desorption isotherms of mesoporous alumina powders prepared from (a) 100 vol% of ethanolic and (b) 20 vol% of 1-BuOH containing precursor solutions.

1) H. Maruoka, A. Tomita, T. Kimura, *Langmuir* **2018**, *34*, 13781-13787.
2) Md. I. Saidul, R. Wakabayashi, T. Kimura, *Dalton Trans.* **2021**, *50*, 7191-7197.