Changes in textural properties of waterglass-based silica aerogel through the addition of DCCA

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ABSTRACT

Silica aerogel have high potential for application in various fields due to their unique properties such as a high porosity, surface area and low thermal conductivity. However, because of the high cost of the precursor as silicon alkoxide, it has a large limitation to commercialization. Waterglass-based silica aerogels have advantageous for commercialization from the material cost. However, the physical properties are lower than the physical properties of silicon alkoxide based aerogel. In this research, acetonitrile as a drying control chemical additive (DCCA) is introduced in the synthesis of silica aerogel for enhancing the physical properties of waterglass-based silica aerogel. The roles of DCCA are to keep the pore size distribution uniformly by van der Waals force and to protect from the agglomeration of particles by steric shielding.

The waterglass-based silica aerogel by ambient pressure drying was synthesized by sol-gel process. A various molar ratio of acetonitrile/Na_2SiO_3 was added to the silica sol. With an appropriate amount of addition, the waterglass-based aerogel showed a high specific surface area (577 m^2/g), a high pore volume (3.29 cc/g), and a high porosity (93%) comparable to the pore-structural properties of silica alkoxide based silica aerogels. It was determined that the addition of acetonitrile as DCCA is effective in improving the pore structure properties similar to the textural properties of silica alkoxide-based silica aerogels.

Keywords: Drying control chemical additive; silica aerogel; ambient pressure drying.

Acknowledgement: This work was supported by the National Research Foundation of Korea (NRF) grant funded by the Korea government(MSIT) (No. 2020R1A5A1019131). This work was supported by the Human Resources Development program (No. 20204030200110) of the Korea Institute of Energy Technology Evaluation and Planning(KETEP) grant funded by the Korea government Ministry of Trade, Industry and Energy.

References

[1] M. Schmidt and F. Schwertfeger, Journal of Non-Crystalline Solids, 225, (1998) 364.
[2] L. Cai and G. Shan, Journal of Porous Materials, 22(6), (2015) 1455.