Nanocellulose porous structures prepared via ambient pressure drying

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Abstract (300 words or less)

Application fields of aerogels are restricted mainly by two problems: the mechanical brittleness of aerogel skeletons, and the high-cost process of supercritical drying. A solution to the former problem is to use cellulose nanofibers (CNFs) as the skeletal component. The CNFs are wood-derived sustainable materials with superior mechanical properties[1,2]. Aerogels with a network skeleton of TEMPO-oxidized CNF combine high optical transparency, low thermal conductivity, and high mechanical toughness[3]. A solution to the latter problem is to apply ambient pressure drying (APD) to wet gels. Dried gels prepared by APD are called xerogels. Although APD is a low-cost and practical process, it typically causes irreversible shrinkage of wet gels by capillary force on the solvent evaporation. Therefore, only a few xerogels with truly aerogel-like structural properties have been reported. In the present study, we report that CNF xerogels with high specific surface areas and high porosities are achieved by optimizing the preparation conditions[4]. A series of material characterizations highlights the uniqueness of the CNF xerogels combining outstanding mechanical strength, moderate light permeability and thermal insulation. As a potential application of the xerogels, lighting yet insulating, load-bearing wall members can be proposed.

References

1. Saito, T., Nishiyama, Y., Putaux, J. L., Vignon, M. & Isogai, A. *Biomacromolecules* **7**, 1687–1691 (2006).
2. Saito, T., Kuramae, R., Wohlert, J., Berglund, L. A. & Isogai, A. *Biomacromolecules* **14**, 248–253 (2013).
3. Kobayashi, Y., Saito, T. & Isogai, A. *Angew. Chem. Int. Ed. Engl.* **53**, 10394–10397 (2014).
4. Yamasaki, S., Sakuma, W., Yasui, H., Daicho, K., Saito, T., Fujisawa, S., Isogai, A. & Kazuyoshi, K. *Front. Chem.* **7**, (2019).