Organic binder-silica composite aerogel for the improvement of mechanical strength

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ABSTRACT

Aerogels are outstanding future materials because of large surface area with a 3-dimensional network of particles, low thermal conductivity, low density, high porosity, and so on. But aerogels have a fragile characteristic for external stress owing to their low mechanical properties. Compositization with organic matter is good solution since organic materials are high mechanical strength because of their hydrocarbon bonds. Due to this, functionalized organic materials can bond to hydrolyzed silica matter chemically, so it is possible to show the improvement of mechanical properties. In this research, the organic binder material, such as 3-(trimethoxysilyl)propyl methacrylate, was hybridized with ceramic nanoporous aerogel to improve the mechanical strength. The functional group of organic binder aerogel can be hybridized with silica or ceramic matter which has reactive hydroxyl(-OH) group. Based on hybridization process, it is possible to make organic binder-silica hybrid aerogel with strengthened mechanical properties. The obtained composite aerogels were analyzed by Fourier transform infrared spectroscopy to check the covalent bonding. The surface morphology and textural properties were analyzed by using scanning electron microscopy. The surface nature was analyzed using contact angle measurement, and mechanical strength was analyzed through the hardness test. Through this analysis, enhancement of many characteristics, such as surface properties, contact angle, thermal properties, chemical bonding, pore properties and mechanical strength were observed. It was confirmed that the surface hardness of composite aerogel was increased due to the formation of the composite structure with organic binder.

Keywords: Mechanical strength; nanoporous structure; organic-silica composite aerogel; organic binder.

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