Title: Influence of catalyst amount on properties of resorcinol-formaldehyde xerogels

Authors: Eva Kinnertová, Václav Slovák

PII: S0040-6031(17)30327-1
DOI: https://doi.org/10.1016/j.tca.2017.12.017
Reference: TCA 77899

To appear in: *Thermochimica Acta*

Received date: 31-8-2017
Revised date: 8-12-2017
Accepted date: 12-12-2017

Please cite this article as: Eva Kinnertová, Václav Slovák, Influence of catalyst amount on properties of resorcinol-formaldehyde xerogels, Thermochimica Acta https://doi.org/10.1016/j.tca.2017.12.017

Influence of catalyst amount on properties of resorcinol-formaldehyde xerogels

Eva Kinnertová, Václav Slovák
Faculty of Science, University of Ostrava, 30. dubna 22, 701 03, Ostrava, Czech Republic
Email: evakinnertova@seznam.cz, vaclav.slovak@osu.cz

Highlights

- Catalyst amount affects the structure and properties of organic and carbon RF xerogels.
- Less catalyst – better adsorption properties, microporosity.
- More catalyst – better mechanical properties, ink-bottle shaped mesopores.
- No effect of catalyst on pyrolysis and oxyreactivity.

Abstract

The effect of catalyst amount on properties of resorcinol-formaldehyde xerogels was investigated. The samples were prepared by sol-gel polycondensation of resorcinol with formaldehyde at three different levels of catalyst (Na_2CO_3, molar ratios of resorcinol/catalyst R/C = 1000, 2000, 3000). The influence on mechanical, thermal and thermomechanical properties of organic xerogels and on properties of carbon xerogels (surface, adsorption and oxyreactivity) was evaluated. The higher R/C ratio leads to increased particle size of the materials, which affects mechanical strength, residual humidity and shrinkage during heating (all parameters decrease). The R/C ratio does not affect significantly pyrolysis process and microporosity of the materials, the effect on oxyreactivity was negligible. Contrary, higher catalyst content (R/C = 1000) lead to relative high volume of ink-bottle shaped mesopores, but this pores are practically unavailable for adsorption of large molecules of methylene blue or hydrated chromate anions, which negatively influenced adsorption of both adsorbates from aqueous solution on the carbon xerogels.

Keywords: Resorcinol-formaldehyde xerogels; catalyst amount; mechanical properties; surface; adsorption; oxyreactivity.

1. Introduction

Resorcinol-formaldehyde (RF) carbon xerogels are monolithic amorphous materials with the interesting properties such as high porosity, high surface area, low density, and chemical resistance [1]. These materials are promising for many applications due to the possibility of controlling their properties via the synthesis, drying or pyrolysis conditions [2]. The high specific surface areas and electric conductivity make these materials good candidates for the elaboration of electrodes for supercapacitors, batteries or fuel cells [3–5]. Their low thermal conductivity is interesting for the development of thermal insulators [6]. The ability to tailor the pore texture of the carbon materials is a great advantage in the fields of adsorption [7–9], catalysis [1] including photocatalysis [10,11] or hydrogen storage [12].

RF xerogels are produced by sol-gel polycondensation of resorcinol with formaldehyde in the presence of alkaline or acidic catalyst. The concentration of reactants (R and F) and the initial pH of aqueous solution [13] are the most important factors affecting the properties of organic gels in this stage of synthesis. The dried polymers, xerogels, are formed by evaporation of the solvent at the ambient pressure. However, the presence of the capillary pressure inside the pores during the drying step may cause changes/degradation of the pore structure of xerogels