Structural Evolution of Silica Aerogel under a Microwave Field

By

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ABSTRACT

Structure evolution of silica aerogel was studied in microwave- and conventionally processed samples over the temperature range from 25 to 1200°C. The samples were produced using sol-gel processing and dried under carbon dioxide supercritical conditions. After drying, the monolithic samples received a thermal treatment at different programmed temperatures in two different ovens, conventional and microwave. The microwave process was performed using a single mode microwave oven at 2.45GHz. Dielectric properties were measured using the cavity perturbation method, and structural characterization was carried out using a variety of techniques, including absorption surface analysis, Helium pycnometry, Archimedes principle, Fourier transform infrared spectroscopy, X-ray diffraction, and high resolution microscopy. The data obtained revealed that structural differences do exist between microwave- and conventionally processed samples.

Three different regions were identified from the structural characterization of the samples. Regions I exhibited a structure densification at temperatures between 25 and 850°C. Region II was characterized by a bulk densification in the temperature range from 850 to 1200°C. Region III was represented by the onset of crystallization above 1200°C. Explanation and possible causes behind the structural differences observed in each region are provided. In general, the structure evolution observed in microwave- and conventionally processed samples followed the same order, but occurred at lower temperature for the microwave process.