

<<新型气凝胶型木质复合材>>

图书基本信息

书名：<<新型气凝胶型木质复合材>>

13位ISBN编号：9787030310958

10位ISBN编号：7030310950

出版时间：2011-6

出版时间：科学出版社

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页数：157

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内容概要

Nano technology and its applications in the field of wood science and technology recently have gained much attention, especially in view of potential for wood modification by the processes of preparing wood-inorganic nano composites. This book reviews recent advances in wood-inorganic nano composite technologies and reports the work of fabricating nano wood-inorganic aerogel composites by the sol-gel process and supercritical drying techniques. This research systematically reviews and discusses technical principles of fabricating wood-SiO₂ aerogel composites. Physical properties and morphological characteristics of prepared wood-SiO₂ composites, distribution of SiO₂ aerogel in wood and mechanisms of compounding between wood and SiO₂ aerogel are also discussed.

This book can be used as a college textbook as well as a reference for researchers in the fields of wood science and technology, wood modification and wood preservation.

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Improving mechanical properties of wood is one of the most important aspects of wood-based nano composites. Evidences have shown that use of non-metallic nanomaterials as fillers in plastic and rubber greatly improve mechanical properties. The modification effects are attributed to great surface area of surface of nano particles which increases adhesion between nano particles and the polymeric matrix. It is expected that the use of nano materials would greatly improve mechanical properties of wood. However, there is little accumulated data to support that expectation, and therefore more research should be focused on this task.

1.3.2 Wood Modification with Nano Materials for Environmental Effects

Application of inorganic nano materials would be able to maintain the environmental properties of wood. Due to small sizes nano materials infiltrated into the cell walls react with cell wall materials and become part of the cell wall and thus able to maintain the capillary system of the cell wall. Nano materials are able to create special surface properties to make the composite either super hydrophilic or superhydrophobic. The basic principle is by chemical means to construct nano-size and geometrically compensating surfaces with nano materials. Strong adsorption of gases (or air) on the surface creates a gaseous membrane covering surfaces of the composite blocking the adsorption and absorption of water or oil by the composite (Wang 2002). It is expected that such technology would be able to increase greatly dimensional stability of wood in which the surface modified by nano materials acts like a surface coating. In addition, the modified surface also would provide color stability and improve acoustics properties. Therefore, it is significant to pursue such technology.

Fumie and Saka (1998) fabricated *Chamaecyparis obtuse* wood-SiO₂ inorganic composites by incorporating biocide TMSAN in the system; the resulting composite showed very good resistance against brown-rot decay but was not resistant against white-rot decay. However, the composite prepared by the HFOETMOS-TMSAH system increased hydrophobicity of the composite, making the composite resistant against both brown-rot and white-rot decay. According to research in Japan, there are three basic methodologies to fabricate wood-inorganic composites with the sol-gel process. Firstly, it is necessary to control the moisture of wood; free water and bound water in wood should be removed and use only the water of constitution to provide water molecules to react with the sol precursors. The second method is to pre-treat wood with coupling agents so as to effectively cross-link metallic organics to wood components for maximizing the effects of improving wood properties. The third is to incorporate fire retardants and biocides in the system and at the same time taking the issue of environmental impacts into consideration by carefully selecting benign chemicals. Research on wood-inorganic composites with the sol-gel process also has been conducted in China.

Wang (1996) fabricated wood-inorganic composites by the sol-gel process with TEOS. It is believed that portion of the SiO₂ gel condenses with cellulose and some fill the cell lumen, forming a net work of SiO₂ gel in wood. In the subsequent research that GPTMS was used as a coupling agent to increase linkage between inorganic SiO₂ and wood components in the cell wall through formation of Si-O-Si and C-O-C bonds and improves the overall property of wood. We believe in the above work SiO₂ nucleus formed in the cell walls of wood and growth of these SiO₂ nucleus resulted in the wood-SiO₂ nanometer composite. Wang et al (2000) fabricated high performance wood-Si-Al-composites with TEOS.

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