

A Comprehensive Review of Plant Fibers: Recent Developments, Challenges, and Future Prospects

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ABSTRACT

In recent years, plant fibers, as a green renewable resource in materials science and global environmental challenges, have received more attention due to their low cost, sustainability and good mechanical properties. This paper reviews the current research status and development trends of plant fibers as sustainable materials. First, we systematically introduce the classification system, chemical composition, microstructure, and physical mechanical properties of plant fibers. Subsequently, we explore extraction techniques and various surface modification technologies for plant fibers. The paper provides an in-depth analysis of the development and applications of plant fiber reinforced composites, and further examines the latest advances in the fields of textiles, biomedical engineering, and energy and the environment. This paper summarizes the key challenges in current research and prospects the future development directions of plant fibers in standardization, intelligent processing, and multi functionalization. This review has comprehensive and forward-looking guide value, and helps to promote plant fibers from laboratory research to large-scale engineering applications.