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### Patent Search

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#### Abstract:

The present invention relates to a smart natural fiber composite material equipped with self-healing capabilities. This composite integrates natural fibers, such as jute and sisal, with a matrix material that includes embedded self-healing agents. The self-healing agents, contained in microcapsules or distributed through a microvasculature within the matrix, are designed to autonomously repair damage to the composite material. When the composite experiences mechanical damage, the microcapsules in the microvascular network activate, releasing the healing agents to bond and repair the damaged areas, thereby restoring the material's structural integrity. The invention includes a method for manufacturing such a composite, involving the preparation of natural fibers, matrix material, and self-healing agents, and the incorporation of components into a cohesive, durable material. This smart natural fiber composite offers enhanced durability, sustainability, and reduced maintenance requirements, suitable for a wide range of applications, including automotive, aerospace, construction, and consumer goods. Accompanied Drawing [FIGS. 1-2]

### Complete Specification

Description:[001] The present invention pertains to the field of advanced composite materials, with a specific focus on natural fiber composites that are environmentally sustainable. More particularly, it relates to the development of smart composite materials that integrate self-healing capabilities, allowing for autonomous repair of damages that occur during use. This innovation addresses the limitations of traditional natural fiber composites by enhancing their durability, extending their service life, and reducing the need for external interventions or repairs.

[002] The invention is applicable across a wide range of industries, including automotive, aerospace, construction, and consumer goods, where there is an increasing demand for materials that are not only high-performing but also eco-friendly. By leveraging the inherent benefits of natural fibers—such as biodegradability, low density, and reduced environmental impact—alongside advanced self-healing technologies, the invention offers a novel solution to the challenges faced in maintaining the structural integrity and longevity of composite materials.

#### BACKGROUND OF THE INVENTION

[003] Natural fiber composites (NFCs) have garnered significant attention in recent years due to their sustainability, environmental benefits, and potential to reduce dependency on synthetic materials. These composites are made from natural fibers, such as jute, flax, hemp, and sisal, embedded in a matrix material like epoxy or resin. The use of natural fibers in composites is driven by their favorable mechanical properties, biodegradability, and lower carbon footprint compared to traditional synthetic fibers.

[004] Despite their advantages, natural fiber composites face several challenges, primarily related to their susceptibility to damage and degradation over time. The mechanical performance of NFCs can deteriorate due to factors such as moisture absorption, impact, or continuous stress, leading to reduced structural integrity and

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