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Mechanical properties, water absorption and chemical resistance of napier grass fibre strand-reinforced epoxy-resin composites

Abstract (summary)

Portable electronic devices are made of non-renewable, non-biodegradable and sometimes toxic materials. They are often discarded, causing environmental contamination. Here we report high-performance flexible electronics with the smallest amount of toxic materials. The electronics are mounted on biodegradable cellulose nanofibril (CNF) papers. We have shown that fungus breaks down the CNF papers. We suggest that it is possible to make high-performance flexible electronics using ecofriendly materials.

Introduction

We made CNF paper from tree fibres, and allowed it to dry. We coated some samples of CNF paper in epoxy resin. We compared the properties of the two types of samples.
We added electronic components to the CNF paper, and checked that the circuits worked.

We investigated the biodegradation of CNF samples by placing them in petri dishes with fungus for 84 days. We measured the mass before and after, and took photographs as the samples decayed.

Results

Properties of CNF paper

The uncoated paper absorbs water, making it unsuitable for electronic devices. The paper coated in epoxy resin does not absorb water. It is transparent. It is unaffected by electrical currents.

Making electronic devices

We mounted tiny semiconductor components (made from gallium arsenide or silicon) on our CNF paper. This made working circuits. We showed that all types of electronic systems required for building an electronic device can be mounted on CNF paper.

The CNF-mounted circuits are highly flexible, and could be wrapped around a stick from a tree.

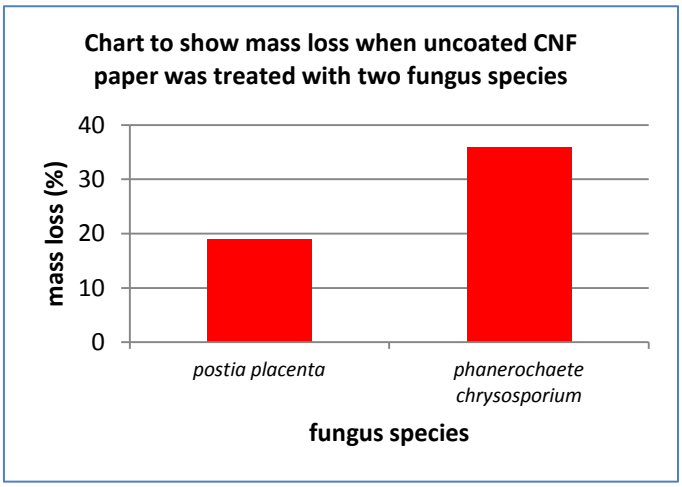
Biodegradation

The bar chart (figure 1) shows the loss in mass of CNF paper when treated with two types of fungus.

Discussion

We demonstrated that it is possible to combine the smallest amounts of toxic and expensive semiconductor materials with biodegradable CNF paper to make working circuits. Our technique would provide ways to make many types of ecofriendly electronics that could help reduce the massive amounts of electronic waste disposed of daily and dramatically reduce the consumption of non-renewable natural resource.

Figure 1



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