FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Fabrications of bio-nanofiber printed electronics	
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1. Background of research

Electronic devices such as displays and mobile phones are fabricated by depositions of many tiny components on rigid circuit boards made of ceramic, glass, or woven fiberglass cloth with an epoxy resin. Recently, there are big issues for their huge energy consumption in high temperature and high vacuum systems, and for their high environmental loadings using hazardous heavy metals or chemicals. Thus, there is a great interest in “printed electronics” that can fabricate electronic devices under the ambient conditions, like printings of newspapers or magazines. Moreover, because printed electronics enable to deposit many components on flexible substrates, the fabricated devices would exhibit high portability, light-weights, and high foldability.

2. Research objectives

The aim of this project is that the near-future electric devices will be fabricated on flexible and light-weight substrates using low power consumption processes.

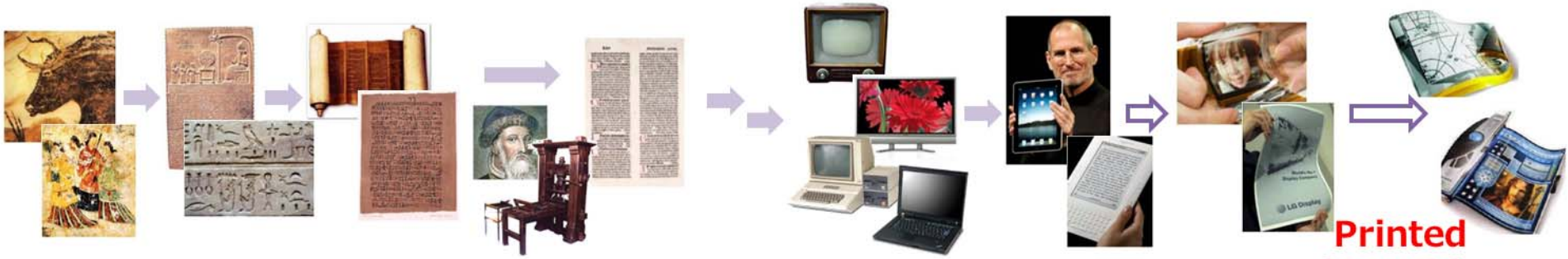
3. Research characteristics (incl. originality and creativity)

From the first innovation of paper in 2nd century BC China, paper is being white and opaque. In 30 Jan 2008, Dr. Nogi innovated an optically transparent “nanopaper” using 15nm width wood nanofibers (Adv. Mater. 2010, DOI:10.1002/adma.200803174). The nanopaper is optically transparent like glass and plastics, high thermal stability like glass, and then high foldability like traditional paper. The renewable material's transparency, flexibility, and thermal stability give it potential advantages over glass or polymers for use in the future bendable electronic devices. In this project, the light-weight and flexible electric devices will be fabricated on the nanopaper substrates using printing technologies.

4. Anticipated effects and future applications of research

This technology makes it possible to realize the flexible or bendable devices of e-books, displays, solar cells, lightings, health-care sensors, batteries and so on. These devices will be mounted on nature’s substrates of “nanopaper”, not on fossil fuel based plastic substrates or “heavy and rigid” glass substrates.

A history of information display media : **light, mobile, process**



Printed electronics

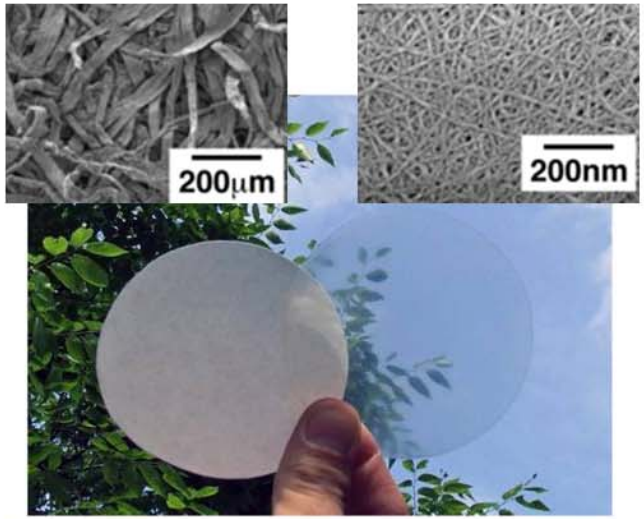
What is the substrate in 21st century?

ultra thin glass

plastics

paper

nanoPaper



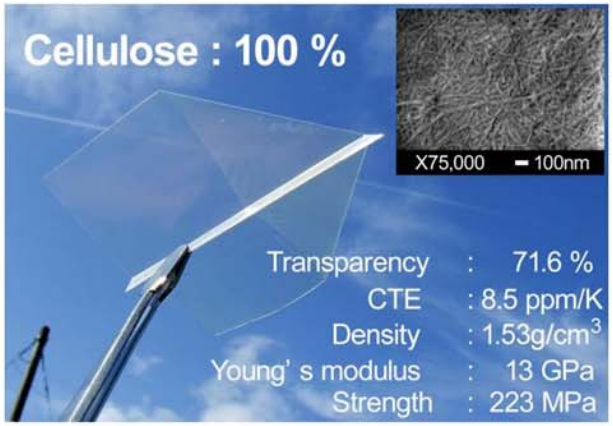
A white paper
until 20th century

using 15μm width fibers

A transparent paper
from 21st century

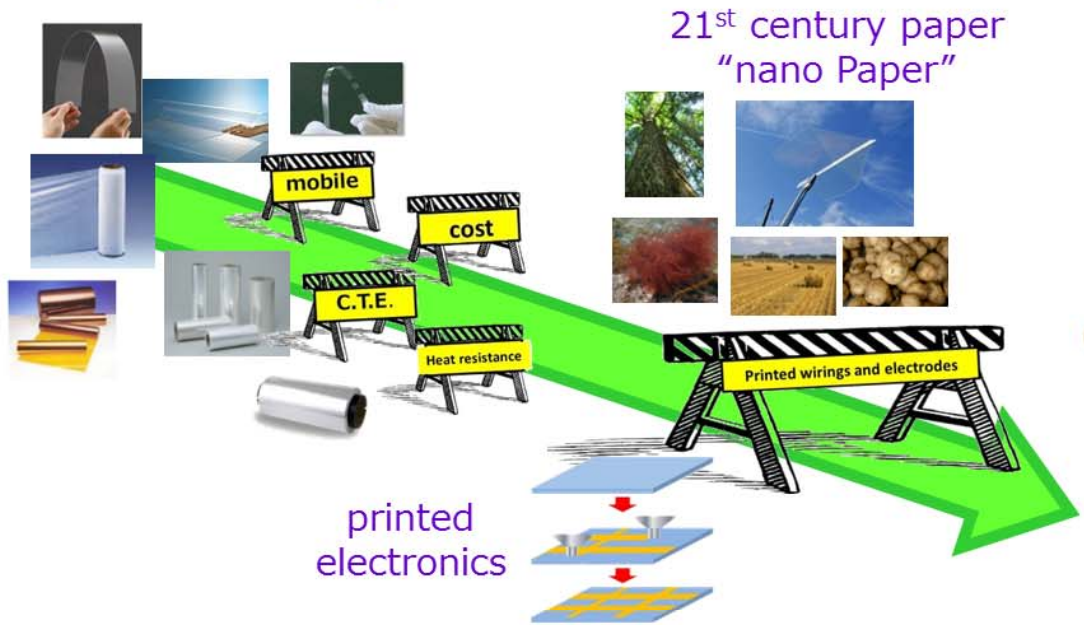
using 15nm width fibers

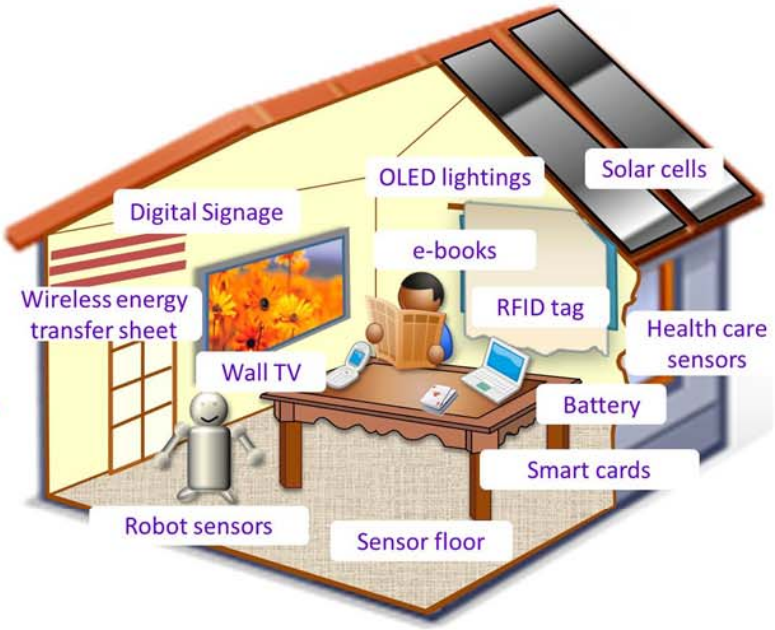
A foldable glass



Biomacromolecules 2007,
DOI: 10.1021/bm700624p
Adv. Mater. 2010,
DOI:10.1002/adma.200803174

Road to the printed electronics





30th century BC
Papyrus paper

15mm width
plants fiber

1st century AD
White paper

15μm width
plants fiber

Jan30, 2008
Transparent paper

15nm width
plants fiber

20XX
Printed electronics
on nano Paper