

# Smart window display using the thermochromic property of hydroxypropyl cellulose

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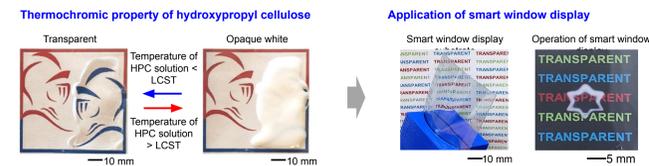
## Research Goal

By controlling the thermochromic property of hydroxypropyl cellulose, the information-providing smart window display can be implemented.

## Abstract

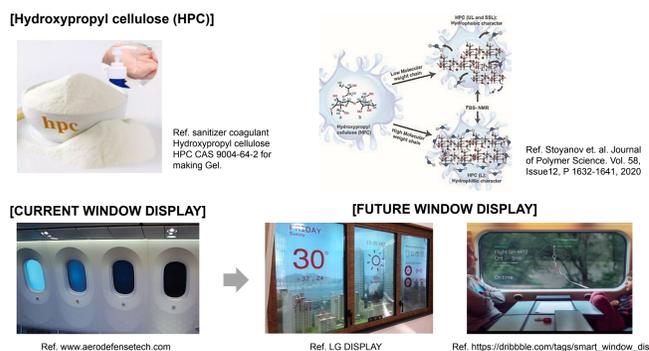
In this study, a smart window display was fabricated using the thermochromic property of cellulose-based hydrogel, which has a transparent color at room temperature but turns into a white and opaque color when it rises above a specific temperature. White color text and images were produced by selectively heating only the desired position on the HPC display substrate, having cellulose and near-infrared absorption-heating film sandwiched between two plastic substrates. The suggested technology is expected to provide a variety of real-time information to users as it can selectively form a transparent and flexible window curtain that can make the desired location optically transparent or opaque.

## Schematic of "Smart window display using the thermochromic property of hydroxypropyl cellulose"

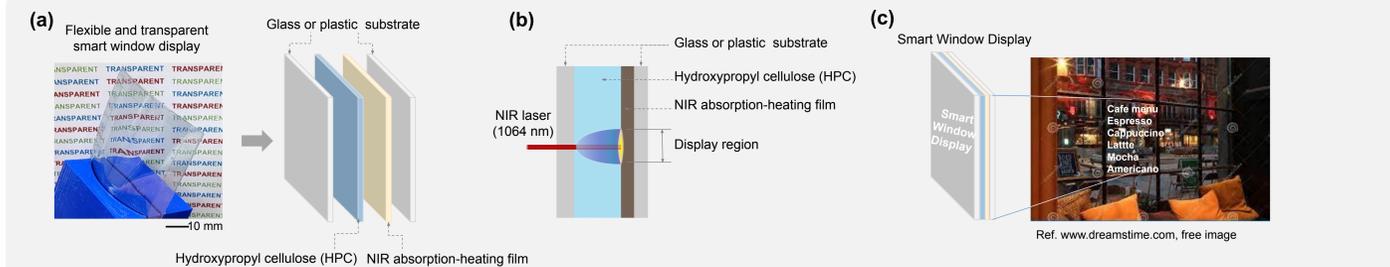


## Introduction

- Hydroxypropyl cellulose (HPC).** Below LCST, the HPC solution appears optically transparent because the HPC becomes hydrophilic and dissolves in the solution. Above LCST, the HPC solution becomes optically opaque because the HPC becomes hydrophobic and aggregates in a powder form in the solution. [1]
- A smart window display** is a novel technology that simultaneously acts as a window and a barrier and can freely control the transmittance of sunlight from outside. [2-9] The most significant limitation is that the existing passive and active window displays, which make the entire window uniformly transparent or opaque, are difficult to use as information-providing displays.
- NEEDS.** It is required to develop a new conceptual smart window display that is simple to fabricate and operate, can block sunlight in a certain area, and has the ability to display valuable information to people.

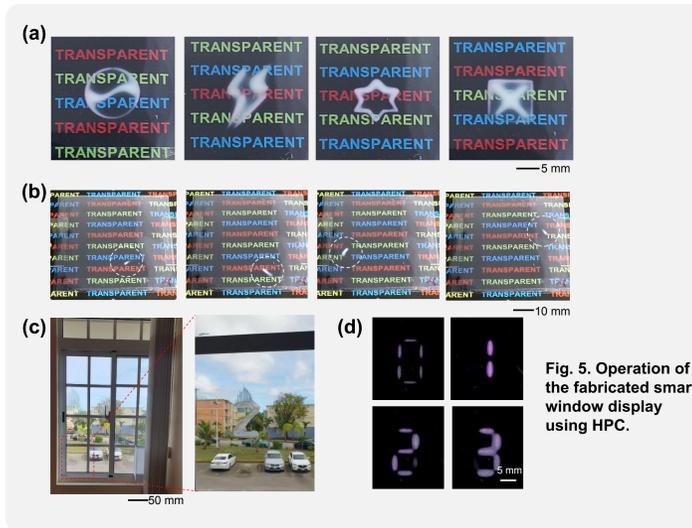
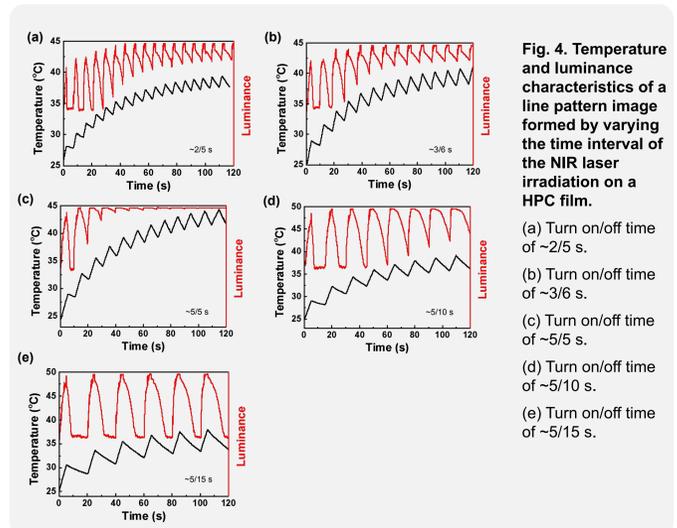
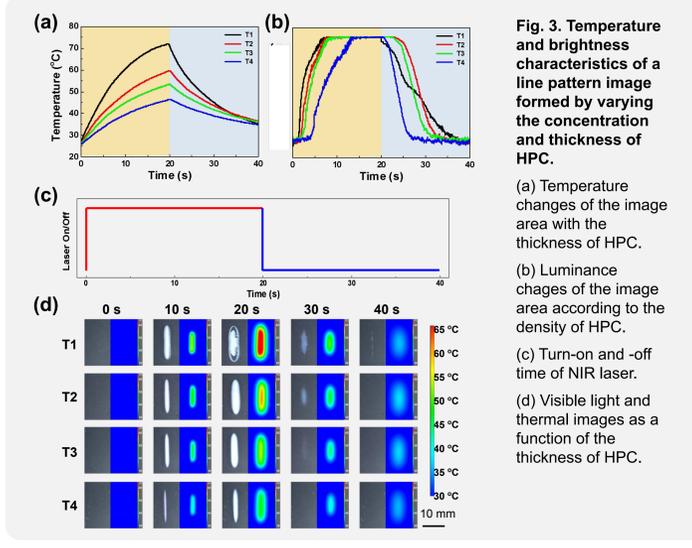
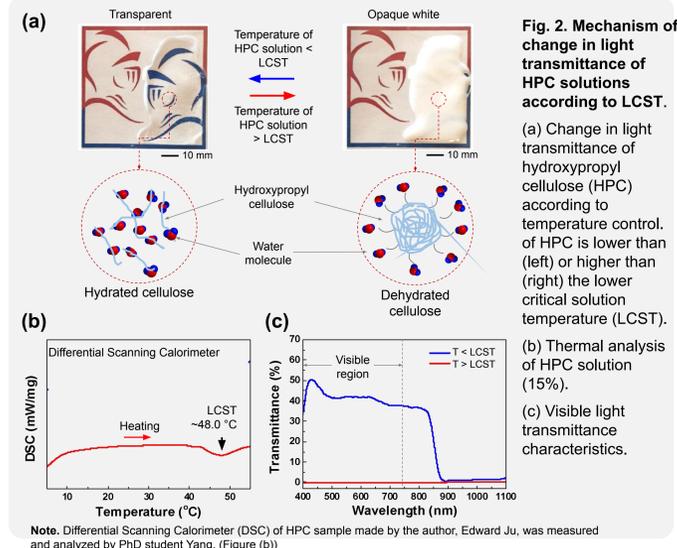


## Experimental



**Fig. 1. Fabrication of a smart window display using hydroxypropyl cellulose.** (a) Photo-image of the fabricated flexible and transparent smart window display. Cross-section view of the hydroxypropyl cellulose display. (b) Operation of the smart window display. (c) Virtual image of a café window equipped with a smart window display using hydroxypropyl cellulose.

## Results and Discussion



## Conclusions

- In summary, an information-providing window display was developed using the thermochromic property of the HPC hydrogel, which changes its color in response to changes in applied temperature.
- When the temperature of cellulose rises above LCST, the water molecules that were hydrogen bonding with the molecular chains of cellulose are separated, and the molecular chains agglomerate and visually appear white
- By using this phenomenon, various types of letters and images could be freely formed only in desired positions.
- The flexible and transparent hydroxypropyl cellulose display can express images and letters in real time by selectively making the desired location transparent or opaque white.

## Future Study - Applications

- This technology can help developing the flexible and transparent display in low cost without the use of electronic circuits.
- The smart window proposed in this study is expected to have high utility in various fields such as construction, space, aviation, and automobiles because it can provide a simple fabrication process, immediate response, selective blocking/permeation function by area, and real-time information.

## Acknowledgement

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