Energy efficient switchable sheet with seasonal shading effect

The sheet automatically blocks sunlight in summer although it is always transparent to viewers inside.

We have developed a new switchable sheet which is based on the fact that there is a change in the incident angle of sunlight between summer and winter. The sheet blocks sunlight in summer by using total reflection but transmits it in winter. Unlike other light-control sheets, the sheet can control the transmission of direct sunlight while always allowing people inside to see the view outside the window. Without any inherent changes, the sheet automatically controls light transmission depending on the season. Light transmission can be controlled simply by attaching the film to an existing window. Therefore, if the sheet can be efficiently produced, it will save energy by substantially reducing cooling and heating loads.

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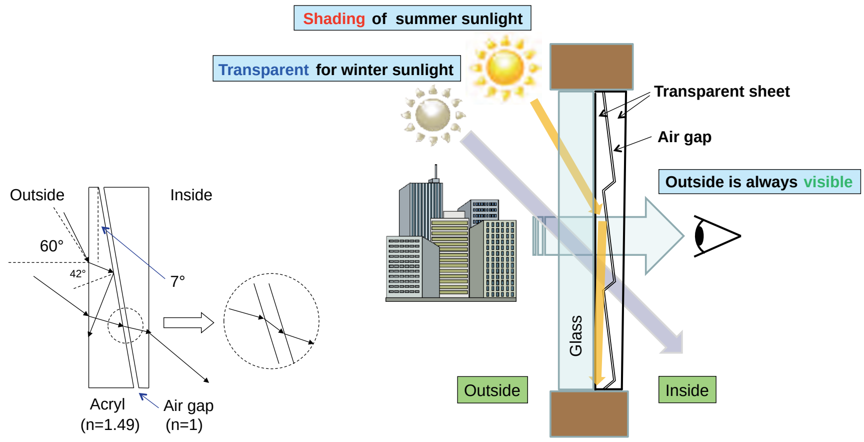

Basic structure of the total-reflection light-control sheet (left) and structure and function of the automatic light-control sheet (right)

Impact of CO_2 geological storage on microbial ecosystems in deep subsurface

Progress toward implementation of CO_2 geological storage

Depleted oil reservoirs are candidate sites for carbon capture and storage (CCS) technology. However, very little is known about how the subsurface microbial community would respond to an increase in CO_2 pressure resulting from CCS. Here we constructed microcosms mimicking reservoir conditions (55 °C, 5 MPa) using high-temperature oil reservoir samples. Methanogenesis occurred under both high and low CO_2 conditions in the microcosms. However, the increase in CO_2 pressure accelerated the rate of methanogenesis to more than twice that under low CO_2 conditions. Geochemical and molecular biological analyses showed that high CO_2 conditions invoked the one-step methanogenic pathway producing methane from acetate in place of the two-step pathway that typically occurs *in situ* environment (low CO_2 conditions). Our results present a possibility of the next-generation CCS for enhanced microbial energy production in deep subsurface environments that can mitigate global warming and energy depletion.

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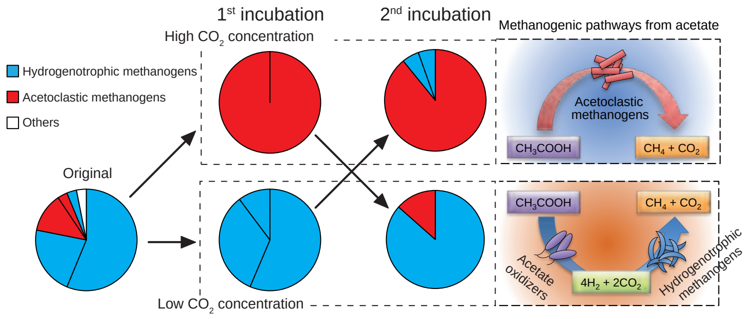

CO_2 concentration-dependent microbial community transition and the methanogenic pathways