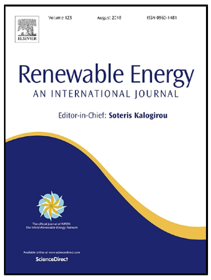

Advances in switchable and highly insulating autonomous (self-powered) glazing systems for adaptive low energy buildings

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PII:	S0960-1481(18)30446-4
DOI:	10.1016/j.renene.2018.04.038
Reference:	RENE 9996
To appear in:	*Renewable Energy*
Received Date:	24 January 2018
Revised Date:	08 April 2018
Accepted Date:	09 April 2018

Please cite this article as: Aritra Ghosh, Brian Norton, Advances in switchable and highly insulating autonomous (self-powered) glazing systems for adaptive low energy buildings, *Renewable Energy* (2018), doi: 10.1016/j.renene.2018.04.038

Advances in switchable and highly insulating autonomous (self-powered) glazing systems for adaptive low energy buildings

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Abstract:

Building energy reduction requires highly advanced low heat loss, heat gain and comfortable daylight allowing glazing. Presently available glazing systems are classified mainly in two categories, controlling solar heat gain and controlling low heat loss. Low heat loss through glazing systems can be achieved by (i) suppression of convection in the air between the outer panes by use of multiple glass panes or aerogels, (ii) having an inert gas or vacuum between the panes to reduce or eliminate respectively convective heat transfer. In all these systems, low emissivity coatings are also required to reduce the radiative heat transfer. Low heat glazing allows large areas of a building façade to be glazed without large attendant heat losses. However, they require the addition of an ability to switch from transparent to opaque to avoid excessive solar heat gain and to control glare. Electrically actuated electrochromic, liquid crystal and suspended particle device glazing systems and non-electrically-actuated thermochromic, thermotropic, and gasochromic glazing systems offer control of solar heat gain control and daylight. Recent relevant developments are reviewed with the contemporary status of each technology provided.

Keywords: Glazing, electrochromic (EC), suspended particle device (SPD), liquid crystal (LC), phase change material (PCM), aerogel, vacuum

1. Introduction:

Glazing visually connects interior spaces with the outdoor environment to offer daylight, conducive to good health and working or living conditions. However, a large glazed area can incur (i) high heat losses increasing a building heating load in cold conditions, and (ii) a large cooling load to remove solar gains in hot conditions. These attributes combined with the energy used to more generally ensure comfort conditions and artificial lighting head to buildings thus consuming 40% of global energy to meet heating, cooling and lighting energy demands, though this varies in different countries. For example 41% of energy in US and the EU but 25% in China [1]. In Japan, the building sector consumes 14.2% energy, which has doubled compared to 1970s [2]. Buildings generate one-third of global greenhouse