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Smart Matrials in Sustainable Architecture and Energy Efficiancy

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Abstract

Investing in refurbishment of existing building stock using energy-saving technologies, such as innovative smart materials, offer an opportunity for housing energy efficiency. Building is the sector with the greatest potential for drastically reducing their energy consumption, reaching the zero emission targets, even for producing energy and returning excesses to the common network, but needs to be supported by the right technologies with energy-efficient solutions. New energy efficient technology based on smart materials fast developing and becomes increasingly cost-effective, with much shorter payback periods. However, smart materials are undertaken only on a limited scale, because of lack of knowledge about their changeable properties and dynamism in that they behave in response to energy fields. Main characteristics, which make them different from the more commonly used architectural materials, are: immediacy, transience, self- actuation, selectivity and directness.

Smart materials and systems are divided in two classes, according to their behaviors until energy stimulus from surrounding environment:

Type 1: materials are those that have capability to change their properties - chemical, mechanical, electrical, magnetic or thermal, including thermochromic, magnetorheological, thermotropic, shape memory alloys. The energy input to a material affects the internal energy of the material by altering the material's microstructure and the input results in a property change of the material.

Type 2: materials are those that have capability to transform the energy from one form to another, including photovoltaic, thermoelectric, piezoelectric, photoluminescent and electrostrictive. The energy input to a material changes the energy state of the material composition, but does not alter the material, it stays the same, but the energy undergoes a change.

Retrofitting homes in this energy-efficient way, in addition to improved indoor climatic conditions, can lead to considerable energy savings together with further enviromental benefits. Smart materials, used in the building refurbishment, can produce direct effects on the energy environment (light, heat and acoustic) or indirect effects on building systems (producing energy or mechanical equipment). Building components and systems that could be improved by application of smart materials are:

Facade systems (smart windows) for controlling thermal conduction and sun radiation through building envelope

Lighting systems (based on optical fiber or light emitting diodes) for optimizing lighting

Energy systems (photovoltaics, micro and meso energy systems) for energy transmission, controlling of generation of internal heating and for optimizing HVAC system

Technological chain involved in the design, production and implementation of smart materials in refurbishment of existing buildings could allow the energy performance of buildings to influence their value. Distributive electricity and heating networks also experience less load intensity due to smart materials, that making better indoor conditions by reducing building's exposure to the fluctuation of outdoor conditions. In addition to contributing to carbon reduction and energy security, using smart materials in interventions in this sector stimulates innovations and regenerates the built environment.

Key words: Smart materials and technologies, changes in energy environment,building components and systems, energy efficiency