Temperature autoregulation in buildings with vanadium oxide coatings

Even in buildings respecting modern insulation regulations, heat losses via walls and roofs can account for up to 25% of the total energy losses attributable to building fabrics. A large part of these significant energy losses could be avoided by introducing a self-regulating material in the envelope of the buildings.

Vanadium dioxide (VO_2) is a smart material with great potential for passive temperature regulation. When it is heated up, its crystal structure is suddenly modified within a narrow temperature range. This results in drastic changes in physical properties. Among other characteristics, VO_2 can transmit or block infra-red radiation depending on the ambient temperature. This property is already exploited for smart windows. However, vanadium dioxide could also be applied in a different way to other structural materials such as bricks or tiles.

The support from COWIfonden will be used to explore the possibility of exploiting the full potential of this material for stabilizing the indoor temperature of buildings and thereby further reducing the energy consumption related to heating and cooling.

The project will address various challenges including:

(i) Tuning the temperature of the VO_2 crystal structure modification to fit real conditions.
(ii) Developing a processing method for coating or impregnating porous building materials.
(iii) Assessing and improving the stability of the material when used under ambient atmosphere.

During the second part of the project, a test setup will be built and used to determine the most efficient configuration in terms of positioning the VO_2 material in a building. These data will allow quantifying the amount of material necessary to achieve efficient temperature regulation.

The support from COWIfonden to this pilot study will enable building the knowledge base necessary for developing a new solution for improved indoor climate regulation with lower energy consumption, which can contribute to the long-term goal of out-phasing the use of carbon-intensive energy sources.

This two-years project starts on July 1st, 2020 and will be realized at the Technical University of Denmark in the Department of Energy Conversion and Storage, under the leadership of Associate Prof. Jean-Claude Grivel.