Design, development and characterisation of nanoporous thermochromic vanadium (IV) oxide coatings for energy efficient glazing

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Glass windows allow natural light to enter buildings, but the main disadvantage is that heat from the sun penetrates, increasing the inner temperature. Therefore, the aim of a smart window is to diminish the solar heat gain dynamically throughout the day without an external control system.

Vanadium dioxide (VO2) is a thermochromic material with a transition temperature (Tc) which allows perspective for implementation into coatings.

• When T of the coating < Tc → near IR light allowed through, therefore heating up the building on the inside.

• When T of the coating > Tc → blocking of IR light.

VO2-based coatings display a low transmission in the visible (~40 %), which is too low for application on architectural glazing. Furthermore, dopants are required to lower the transition temperature from 68 °C to 20-30 °C. However, dopants reduce the switching temperature and solar modulation behaviour. The objective is to a develop nano-porous thermochromic VO2-coating, with a switching temperature between 20-30 °C, and increased transmission in the visible.

A liquid citrato-oxalato-VO2+ solution is dried using a freeze dryer, this solid complex is annealed under nitrogen in a tube furnace. Many parameters need to be monitored, the main ones are; heating rate, final temperature and isothermal period at final temperature. Annealing allows the formation of the VO2 and removal of organic material.

The quality of the produced monoclinic VO2 depends on the parameters, therefore the dependence on each is investigated. High temperatures remove more organic material and improve the quality. Further optimisation is required to form the desired phase of VO2, without oxidising the vanadium to other phases. Additionally, comparison with doped precursor with different metals will be carried out.