Electrochromic Materials: adjustment of composition, structure and morphology for devices and applications

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Electrochromism is known as a modulation of the optical properties under an applied voltage. Applications are multifold. In buildings and automobile industry, transmissive devices allow the control of light and heat transfer through windows while color changes in reflective devices offer great interest in the field of displays and printed electronics. In the infrared region, the optical properties modulation (i.e. modulation of emissivity) is well suitable for thermal control in satellites or IR furtivity. Targeting diverse applications requires to play both with the nature of the materials as well as the device configuration. Our approach combining both issues will be illustrated through various examples.

Starting from the "state of the art" oxide, namely WO_3, that switch from a transparent to a blue state upon reduction, we will demonstrate how one need to optimize the synthesis route in respect of the substrate nature [1]. The key role plays by the stoichiometry on the electrochromic mechanism will be investigated in NiO based systems [2]. The use of organic materials will be discussed based on recent achievement considering the conductive polymer, poly(3,4-ethylenedioxythiophene, PEDOT. Successful activation of PEDOT based ECD thanks to a smart phone was achieved aiming at designing counterfeit labels. A step forward in improving the materials properties was addressed by combining oxides and conductive polymers allowing a fine tuning of the color [3]. Finally, extending the chromogenic property and the type of stimulus to temperature, the properties of vanadium oxides will be discussed in respect of the oxide stoichiometry, that is to say electrochromism for V_2O_5 and thermochromism for VO_2 [4].

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