Large area electrochromic glazing with ion conducting PVB interlayer and two electrodeposited complementary electrochromic layers

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Introduction

Since more than 30 years research efforts are taken to develop large area electrochromic glazing for architectural applications [1]. However, until today no product has entered the market. This is mainly caused by cost, performance and stability problems of the different device and fabrication concepts which were considered so far [1].

The new concept of Gesimat [2] offers the possibility of a relatively low cost production process, high switching range and long term stability. This concept is based on the use of two complementary electrochromic layers prepared by electrodeposition in combination with an ion-conducting polymer electrolyte using PVB as polymer. PVB (polyvinyl butyral) is in use for laminated safety glass since about 60 years. The well known technologies for the production of conventional PVB interlayers and for the production of laminated safety glass can now also be used for the manufacture of electrochromic glazings [2].

Experimental

The structure of the laminated electrochromic glass of Gesimat is shown in figure 1. Two sheets of FTO coated glass (FTO … fluorine doped tin oxide) are coated with complementary inorganic electrochromic layers. For this purpose tungsten oxide and Prussian Blue are choosen. Both are deposited by electrodeposition from aqueous solutions. At the moment areas up to 1.2 m x 0.8 m can be coated.

The ion-conducting PVB foil is produced by extruding a mixture of the PVB with plasticizer and Li ion containing salt to a polymer sheet in a process similar to the extrusion of PVB interlayers for laminated safety glass.

The two FTO coated glass panes with tungsten oxide and Prussian Blue overlayers are laminated together via the ion conducting PVB foil under elevated temperature and pressure.

The solar transmittance curves in the wavelength range of the solar radiation at 20 °C were measured using a UV-VIS-NIR spectrometer. The solar transmittance T_{solar}, as well as the visible transmittance T_{vis}, were derived from the spectrometer data according to the European standard EN 410.

Results and Discussion

Transmittance spectra of the new electrochromic device in the fully bleached and colored states are shown in figure 2. A change of the visible light transmittance from about 8 % in the colored to 77 % in the bleached state is possible. Very good values for the photopic transmittance ratio (PTR = $T_{vis\text{-}bleached}/T_{vis\text{-}colored}$) can be achieved. Due to the use of two complementary electrochromic layers which both take part in the desired light regulating effect, PTR is more than 9:1. The solar transmittance can be changed between 6 and 56%.

The switching time strongly depends on the size of the electrochromic glass but can be accelerated by use of an advanced electronic control system.

Currently, several durability tests are performed with promising results.

Conclusions

The new device and fabrication concept for an electrochromic window developed by Gesimat offers the possibility for a cost effective production of large area electrochromic glazing with high contrast ratio and long term stability in the near future. Possible application areas include architectural and automotive smart glazings.

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References

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2. H. Stenzel, A. Kraft, K.-H. Heckner, M. Rottmann, M. Steuer and B. Papenfuhs, *Glass Processing Days 2003, Conference Proceedings Book*, p. 423-426.

Figures and Captions of Figures

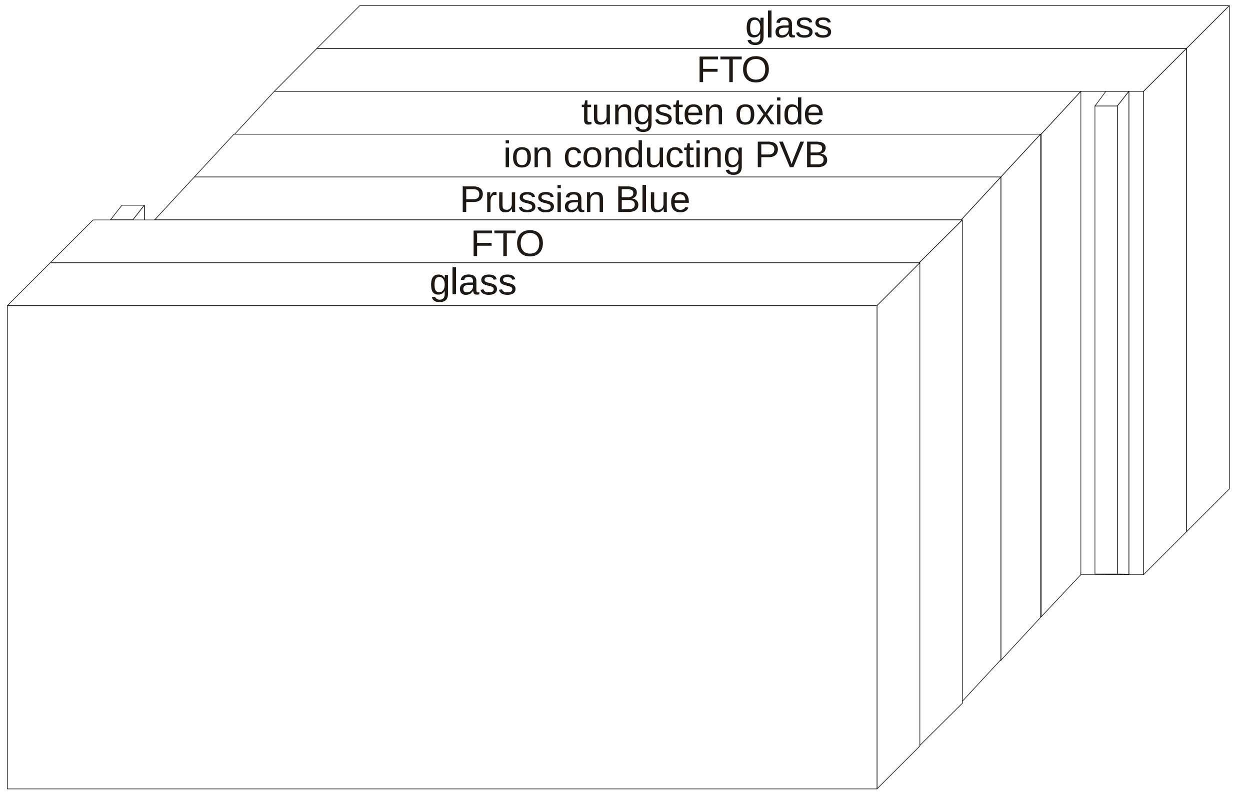

Fig. 1: Structure of the Gesimat electrochromic device.

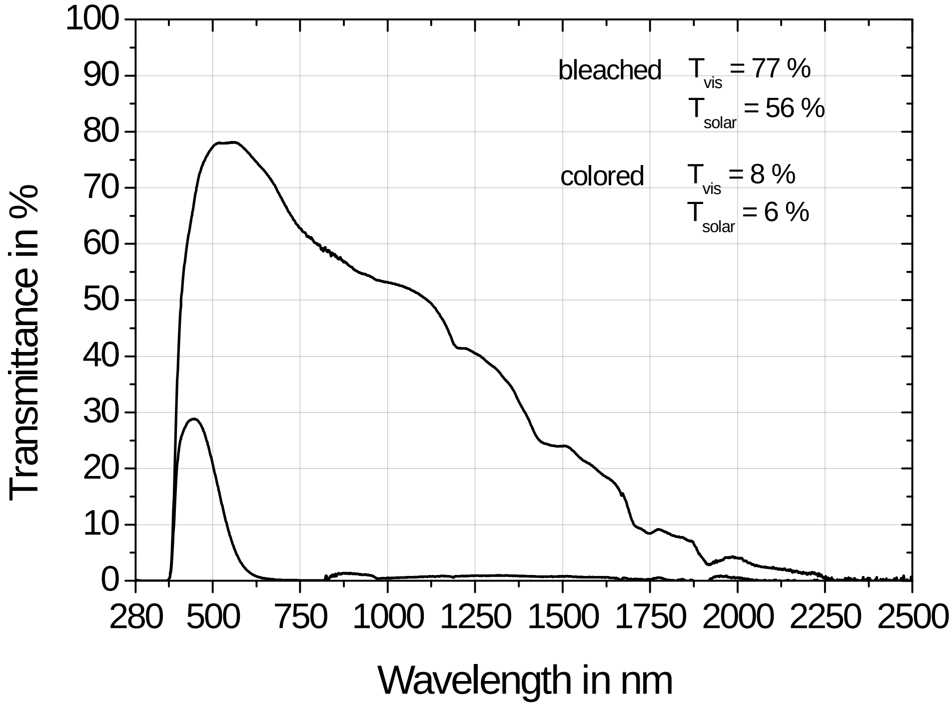

Fig. 2: Transmittance spectra of the Gesimat electrochromic device in fully bleached and colored state.