Sputtered TiO_2 and WO_3 films for Photoelectrochromic Device

Shankar Bogati, Carmen Jerg, Andreas Georg, Wolfgang Graf

Fraunhofer Institute for Solar Energy Systems, Heidenhofstr.2, D-79110 Freiburg, Germany

Abstract

Photoelectrochromic windows are considered as one of the promising candidates for day lighting control. So far, the most common titanium and tungsten oxide films for photochromic and photoelectrochromic applications have been prepared from colloids or sol-gel chemistry with high porosity and surface area. We have, for the first time, successfully developed a photo-electrochromic device with conventionally sputtered titanium oxide and tungsten oxide films. This is attractive due to the well documented upscaling capability and industrial viability of sputtering technology for window applications.

The photoelectrochromic devices have the following layer configurations;

Glass / TE / PA / EC/ RE / Cat / TE/ Glass

Glass/TE: transparent electrode; **PA**: photoactive layer (TiO_2); **EC**: electrochromic layer (WO_3); **RE**: redox electrolyte; **Cat**: catalytic layer; **TE**: transparent electrode/ Glass

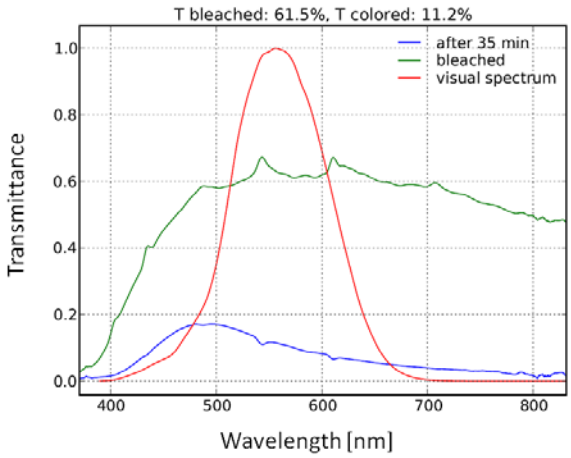

Figure: Photoelectrochromic device with the visual transmittances of 61.5 % (green) and 11.2 % (blue) at bleached and colored after 35 min, respectively, under 1.5 A.M. solar illumination

Here, the photoactive layer is realized by a sputtered layer of TiO_2, followed by a dye adsorption process similar to dye solar cell technology. The electrochromic layer is applied by sputtering WO_3. The redox electrolyte comprises iodide and triiodide as well as Li^+ ions.

The layers have to be porous enough to allow a permeation of dye during immersion in dye solution as well as of Li^+ ions and I^- and I_3^-. Furthermore, it was found that an annealing of the TiO_2 layer improves the dye adsorption. However, such an annealing affects impacts the porosity of WO_3 layer. That´s why the TiO_2 layer is first sputtered, then annealed, and subsequently WO_3 is sputtered. However, annealing was found not to be essential for the optical switching.

The visual transmittance can be switched from 61.5 % to 11.2 % with switching time of 35 min under 1.5 A.M. illumination from PEC device using sputtered photoactive (TiO_2) and electrochromic (WO_3) layers as shown in Figure above.