Tungstate-Based Electrochromic Thin Films

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Layer-by-layer assembly was used to alternately deposit tungstate anions with cationic poly(4-vinylpyridine-co-styrene) to generate electrochromic thin films that transition from transparent to dark blue in their oxidized and reduced states, respectively. Tungstate is a good electrochromic material because it is completely colorless in its deposited state, while most other electrochromic materials exhibit some type of color in the absence of an applied voltage. Despite its advantages, tungstates are plagued by long switching time (> 30 seconds), which is common amongst ceramic electrochromics, due to lack of electrical conductivity in at least one of the two states. In an effort to decrease switching time, indium tin oxide (ITO) nanoparticles were incorporated into these tungstate-based assemblies. In the absence of ITO, these films take 30 – 60 seconds to completely switch and exhibit reduced contrast with each switch. ITO-containing films, with ITO in every other bilayer, fully switch in 14 seconds and do not exhibit the same drift in transmittance with repeated switching. ITO allows these films to maintain electrical conductivity in both states, which is the source of this faster, more stable switching. With further optimization, this combination of fast switching and high contrast makes these films promising for use in smart windows and flexible displays.

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