Electrochromic materials for visible and near infrared light modulation

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Electrochromic materials can reversibly change their optical properties by varying the external electrical stimuli. Since the first experimental demonstration of electrochromic phenomenon in tungsten oxide, electrochromic technology has been extensively developed. Currently, electrochromism based devices can be found in windows of energy efficient buildings, smart phones, goggles, information displays, anti-glare rear-view mirrors, etc. In inorganic electrochromic materials, transition metal oxides are most studied, and oxide thin films can change colors and transmittance of the near-infrared between a transparent and a colored state upon small ion intercalation. In an electrochromic material or device, an ideal scenario is that visible and near-infrared light can be independently regulated, that is bright mode (both VIS and NIR are highly transparent), cold mode (transparent for VIS but not for NIR), warm mode (transparent for NIR but not for VIS) and dark mode (both VIS and NIR are blocked). However, electrochromic devices typically suffer from single-mode control, i.e., simultaneously varying the visible and near-infrared light. Electrochromic effect combined with surface localized plasma resonance (LSPR) were recently found to be able to sequentially modulate near-infrared and visible light. In this talk, we report our recent progress on dual-band modulation, with a special focus on achieving a transition from bright mode to warm and dark mode, as well as bright mode to cool and dark mode. We believe our findings show substantial fundamental insight into electrochromism in cathodic oxides, and provide a new starting point for designing electrochromic devices with superior performance.