All-solid-state Electrochromic Devices on Glass and Flexible Substrate

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A complementary electrochromic (EC) device is generally composed of a transparent substrate, transparent electrically conducting layer, cathodic and anodic coloring materials, and an ion-conducting electrolyte. As a transparent substrate, glass has been widely used because of its better thermal stability in window application. However, these devices built on glass substrate are so stiff that it could not be suitable for needs of varying its shape.

In this study, all-solid-state EC device on flexible substrate was fabricated. First, each W oxide and Ni oxide was prepared by rf magnetron sputtering on polymeric substrate coated with indium tin oxide (ITO). Ta oxide was then deposited upon W oxide and Ni oxide, respectively, as a protective layer [1]. To make each oxide active EC forms, pre-treatment was performed through several continuous potential cycling in liquid electrolyte. Figure 1 shows *in situ* transmittance curves for (a) Ta oxide/W oxide and (b) Ta oxide/Ni oxide during the potential cycling. Transmittance differences were grown up during the several initial stages (represented by circles) and then kept being stable through entire cycling, which means each film is fully transformed to EC active form.

Before fabricating a full device, electronic and micro-structural properties of each W oxide and Ni oxide were investigated by atomic force microscopy (AFM), scanning electron microscopy (SEM) and x-ray photoelectron spectroscopy (XPS). Interfacial properties between polymeric substrate and ITO were also studied by a.c impedance. The electrochemical behaviors of each film were investigated by cyclic voltammtry and chronoampe-rometry. The optical transmittance was simultaneously measured *in situ* during all experiments by using He-Ne laser (633 nm). An optical memory was detected under the voltage-off state after a cathodic potential is applied for 1 minute. The durability test was also conducted through pulse potential cycling between the specific cathodic and anodic potential, which was compared with devices fabricated on glass substrate.

Reference

[1] Kwang-Soon Ahn, Yoon-Chae Nah, Yung-Eun Sung, Ki-Yun Cho, Seung-Shik Shin, and Jung-Ki Park, Appl. Phys. Lett. **81** (2002) 3930.

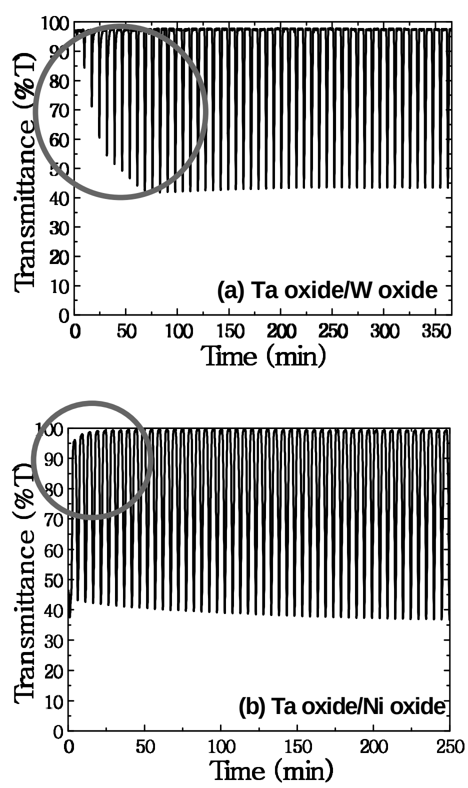

Figure 1. *In situ* transmittance curves for (a) Ta oxide/W oxide and (b) Ta oxide/Ni oxide during the potential cycling.