Effects of Sputtering Pressure on Electrochromic Properties of NiO films Prepared by DC Magnetron Sputtering

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二.成果简介：

Based on that little dedicated work investigates effects of sputtering pressure on the electrochromic properties of NiO films. In this study, nickel oxide films were deposited on ITO-coated glass substrates by DC magnetron sputtering at different pressures(1.2Pa~3.0Pa). The effects of sputtering pressure on microstructure and electrochromic properties of nickel oxide films were investigated. The film thickness was measured by a surface profilometer. The crystal structure and surface morphology of the films were observed by X-ray diffraction (XRD) and scanning electron microscopy (SEM). The electrochromic properties of the films were studied by combining UV-visible spectrophotometer with electrochemical workstation. And the test results offer an important reference value for establishing the deposition pressure as a characteristics parameter to control NiO-based ECDs.

三. 主要研究内容及创新点：

NiO films were prepared by DC magnetron sputtering under different deposition pressures, and the effects of deposition pressure on the microstructure and electrochromic properties of NiO films were investigated. The thickness of the films was measured by a surface profilometer and it was found that the deposition rate of the films decreased when the pressure increased. And the crystalline quality of the NiO films decreased when the deposition pressure increased as demonstrated by XRD patterns. The surface morphology of the films was observed by SEM images, which proved that the appropriate deposition pressure could effectively improve the surface morphology of the films. Comparing the XRD patterns and SEM images of NiO films before and after electrochemical cycling, it can be found that the surface cracks of the films increased after cycling and the crystal shape changed from round granular to irregular granular, which may be related to the insertion and extraction of ions during the redox reaction. The electrochromic properties of the films were analyzed by cyclic voltammetry and chronoamperometry, and the data showed that the films deposited under 2.4 Pa pressure reached an optical modulation amplitude of 57.19% at the wavelength of 550 nm after 200 electrochemical cycles of activation, with fast switching speed (t_c=4.63s, t_b=4.87s), and the coloring efficiency could reach 33.59cm^2/C. After 500 electrochemical cycles, its optical modulation could continue to increase to 61.49%, and its coloring efficiency could still be maintained at about 28.21cm^2/C, showing excellent cycling stability. In summary, the electrochromic properties of NiO films prepared by DC magnetron sputtering can be regulated by controlling the deposition pressure, and the selection of a suitable deposition pressure can contribute to the improvement of the electrochromic properties of the films, which is an important reference value for establishing the deposition pressure as a parameter for controlling the characteristics of NiO-based ECDs.

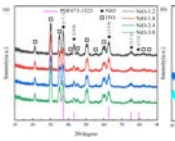


图 1 NiO 薄膜 XRD 图谱

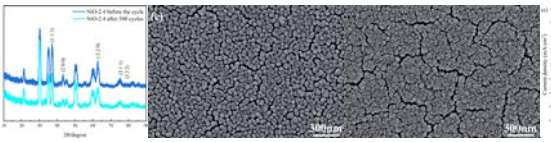


图 2 NiO-2.4 SEM 图像（循环前和循环后）

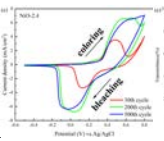


图 3 NiO-2.4 CV 曲线

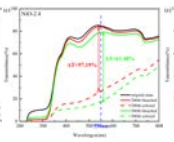


图 4 NiO-2.4 200-800nm 透过率曲线

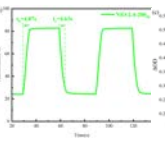


图 5 NiO-2.4 200 次循环后响应时间曲线

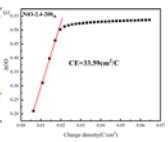


图 6 NiO-2.4 200 次循环后着色效率曲线

四. 主要研究成果及应用情况

在 Journal of The Electrochemical Society 发表论文 1 篇。

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