Structural and Electrochromic Properties of IR-MOF-74 III Thin Films on Functionalized FTO Substrates

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Metal–organic frameworks (MOFs) are porous crystalline materials with tunable structures and electronic properties, enabling applications in sensing, catalysis, and electrochemical and optoelectronic devices [1,5]. In this work, IR-MOF-74 III thin films were grown directly on fluorine-doped tin oxide (FTO) glass and their electrochromic response was investigated as a function of substrate surface chemistry.

Prior to solvothermal growth using the extended LINK-III ligand and divalent metal centers (Ni, Co), FTO substrates were modified with silane coupling agents (3-aminopropyl)triethoxysilane (APTES), glycidoxypropyltrimethoxysilane (GPTMS), and (3-mercaptopropyl)trimethoxysilane (MPTS), while non-functionalized FTO served as a reference. The resulting films formed adherent coatings that preserved the MOF-74 topology. X-ray diffraction (XRD) and scanning electron microscopy (SEM) confirmed crystallinity and surface coverage, whereas FTIR and Raman spectroscopy verified framework formation and interfacial bonding. UV–Vis spectroscopy enabled monitoring of optical modulation.

Electrochemical and spectroelectrochemical measurements, including cyclic voltammetry and in situ transmittance, revealed reversible electrochromic behavior associated with redox processes at the metal centers. Surface functionalization influenced film adhesion, charge transfer, optical contrast, and switching kinetics, demonstrating that interfacial engineering is crucial for optimizing electrochromic performance. These results highlight IR-MOF-74 III thin films as promising materials for electrochromic devices and smart-window technologies [2–4].

References

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