$SrFe_{0.9}Mo_{0.1}O_{3-\delta}$ epitaxial thin films grown by PLD for CO_2 conversion

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The need to lower CO_2 emissions and achieve a sustainable energy sector is becoming increasingly pressing as the impacts of climate change become more evident. To tackle carbon emissions, research is being conducted to find viable methods for removing CO_2. One of the most commonly used materials for CO_2 decomposition is cerium oxide, but is limited by the high energy cost associated with the high temperature, 1500 °C, required [1–3]. Transition metal oxides and their derivatives, have shown promising behavior at more moderate temperatures but cyclic half-life of these materials is limited, which reduces their long-term viability as catalysts [4–6]. Therefore, there is a need to find novel materials for this purpose. Double perovskites can be synthetized in a wide range of composition which allows for fine-tuning their properties. They have shown the possibility of operating at temperatures of 800°C for CO_2 decomposition and a longer cyclic life [7,8]. In this work, we have successfully grown epitaxial thin films of $SrFe_{0.9}Mo_{0.1}O_{3-\delta}$ on SrTiO3(001), SrTiO3(111) and LaAlO3(001) substrates using pulsed laser deposition (PLD). These materials have been grown as epitaxial thin films to exploit the benefits of epitaxial growth to perform material engineering by modeling their properties and behavior through the modification of the growth conditions, and develop novel materials with enhanced performance and functionalities for catalytic applications. The substrates on which the films are grown, have an effect on the crystalline structure of the thin film, as found by synchrotron-based Grazing Incidence X-Ray Diffraction performed in the 3 samples, causing an impact on its stress state, due to the lattice mismatch with the substrates. A correlation with the chemical composition and oxidation state of the films have been studied by combination with Hard Energy X-ray Photoelectron Spectroscopy as well as X-ray Absorption Spectroscopy. Conductivity measurements were also performed at high temperatures under different reductive (vacuum and N_2) and oxidation gases (O_2, H_2O and CO_2) to correlate the microscopic properties of the thin films with their catalytic activity.

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