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Fabrication of Crystalized Functional Oxide Thin Films on Flexible Polymer Substrates

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Since the report of transparent flexible thin-film transistors consisting of oxide materials [1], the field of flexible oxide devices has been rapidly developing. In most studies of the field, a polymer film is used as the flexible substrate. Because these polymer films have low heat-resistive property, the key of the studies has been to reduce the growth temperature. In order to realize the low growth temperature, one of the most conventional studies is to explore an amorphous oxide material with excellent properties such as high carrier mobility because amorphous materials can generally be prepared even at room temperature. These studies have brought fruitful results for an application of the amorphous oxide semiconductors. On the other hand, one of the most "traditional" application of the oxide materials has not been examined yet in the field of flexible oxide devices, i.e., harmonization of the various electronic functions. To realize the application, multilayered epitaxial oxide system is required. However, the epitaxial growth of the functional oxides is impossible on the flexible polymer substrate due to its low heat-resistive property.

In this study, we propose a preparation method of the epitaxial thin films of the functional oxides on flexible polymer materials. This method will bring a possibility to prepare a multifunctional multilayered epitaxial oxide system with flexibility.

The detailed preparation process we have developed is an application of our previous study for the freestanding hydroxyapatite sheet [2]. An epitaxial functional oxide thin film was deposited on single crystalline MgO(100) substrate by pulsed laser deposition with a KrF excimer laser. The thin film surface was then bonded to polymer film. We have examined two techniques for the bonding step. One is to use an adhesive [3] and the other is to use a direct bonding by oxygen plasma irradiation [4]. After the bond process, the sample was soaked in phosphoric acid aqueous solution to dissolve the MgO substrate [5]. By the process, the epitaxial functional oxide bonded to the flexible polymer remains. The electronic properties of the prepared epitaxial functional oxide thin films on flexible polymer substrates are reported.

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