Creation of hybrid energy materials with highly ordered nano-structure

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【Outline of survey】

In order to improve the energy efficiency of energy materials, many research groups have researched and developed functional energy materials. In particular, various oxide-based materials such as thermoelectric materials, superconductors, and magnetic materials are expected to be used as energy and device materials. About twenty years have elapsed since high-T_c oxide superconductors were discovered, many fundamental studies have been conducted on their physical properties using single crystals. Furthermore considerable knowledge has been acquired regarding the development of processing technologies for superconducting thin films and single crystals and the applied technologies for superconducting wires and devices. In order to determine the growth mechanism of superconducting films, we investigated surface growth of superconducting films via hetero-epitaxial growth on a substrate by observing the microstructure. In addition, we have investigated crystal growth mechanisms in thin oxide films, such as the vapor-liquid-solid (VLS) growth mechanism.

To improve thermoelectric materials which are expected to be used as energy materials, we have started to investigate energy material technology with a view to developing “environmentally safe materials” that have “new functions”. We are seeking to achieve by integrating recent advances in film growth technology and by controlling interfaces using the nano-technology based on the VLS growth technique.

【Expected results】

In order to develop highly efficient energy materials, especially functional thin film, in this study we developed and investigated a thin film growth mechanism that produced thin films with “new functions”. We achieved this by integrating the control of interface technology by (i) using an advanced thin film growth process that uses nano-technology, (ii) controlling the growth of interface, (iii) controlling the compositions and micro-structures of the films, and (iv) using multilayer technology. Furthermore, using these thin film growth processes and controlling of the interface, we intend to develop evaluation technology and composite technology for produced highly effective thermoelectric materials using nano-wire and oxide/non-oxide materials.

【References】

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