Abstract of Presentation

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Presentation Title(Should be no more than 20 words):

Layer-by-Layer Design and Fabrication and On-Demand Oxygen Engineering of Novel Functional Oxide Materials for Future Energy Technologies

Abstract :

Transition metal oxides play central roles in many important future energy technologies. The apparent examples include the next-generation thermoelectric devices (***electricity from heat***) based on cobalt oxides, solid-oxide fuel cells (***electricity from fuels***) based on a tailored combination of various oxide materials, Li-ion batteries (***electricity storage***) based on oxides of cobalt, manganese, iron, titanium, *etc*., and high-T_c superconductors (***electricity transmission***) based on copper oxides (or iron arsenides). Moreover, smart oxide materials are sought for the storage and/or separation of the related utility gases, such as hydrogen and oxygen. Just to highlight one recent material invention in this field: the mixed yttrium barium cobalt oxide $YBaCo_4O_{7+\delta}$ possesses unique low-temperature oxygen absorption/desorption characteristics making this material an excellent candidate to be employed *e.g*. as an efficient oxygen-gas separator urgently demanded to make the photocatalytic decomposition of water by sun light feasible.

A majority of (multi)functional oxide materials to be potentially employed in the emerging energy technologies possess – in common – a (multi)layered crystal structure and nonstoichiometry in terms of oxygen. Hence atomic-level layer-engineering and oxygen-engineering techniques are indispensable to expand the material frontier and to shape the new materials into optimized performance.

The present lecture is a short and subjective summary of the status of new-material research in the field of energy-related functional oxide materials in the two countries, Japan and Finland, regarding the four fundamental elements of new-material research: (*i*) new compounds, (*ii*) new properties/functions, (*iii*) new forms of material, and (*iv*) new material combinations.