High-throughput screening of binary and ternary dielectric oxides by combinatorial technology

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Novel phases of functional inorganic chemical systems can be efficiently explored using a mask-defined integrated thin-film fabrication technique coupled with rapid characterization schemes[1]. This kind of high-throughput investigation of thin-film materials has already led to the discovery of new dielectric and magnetic oxides. Here, we report our advanced composition spread methods which enable concurrent screening of binary and ternary phase diagrams with a focus on their application to action of a shadow mask and substrate rotation or specially patterned mask scheme.

Films are fabricated in the combinatorial laser MBE system equipped with screening of multi-components dielectric and light emitting oxides. The methods creates triangular ternary phase diagrams of AOx-BOy-Coz systems where each end composition cycle is linearly varied from zero to 100% using either the synchronous combinatorial masks and a substrate heating device by the fiber-interfaced Nd-YAG laser [2]. The film thickness of a deposition cycle is kept constant at one molecular layer in the entire of the spread by the computer control of mask movement, target exchange, and laser pulses. Besides ternary phase diagrams, three binary phase diagrams (Aox-BOy, BOy-COz, COz-AOx) can also be made simultaneously. The obtained spread libraries are characterized by scanning microwave microscope and cathode luminescence to evaluate the dielectric and light emitting properties, respectively. Results and discussion will be presented on the screening of amorphous high dielectric oxides and cathode luminescent rareearth containing oxy-borates.

References

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2) H.Koinuma, JST-Crest Highlight, 2, 20-22(2002)