【Grant - in - Aid for Scientific Research on Innovative Areas(Research in a proposed research area)】

Science and Engineering

Title of Project : Materials Science on Synchronized LPSO Structure – Innovative Development to Next-generation Lightweight-structural Materials –

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【Purpose of the Research Project】

New ultra-high-strength magnesium-base alloys have been developed in Japan and are now the focus of wide attention in many parts of the world. The new alloys are strengthened by a unique phase having a novel structure called "Synchronized Long-Period Stacking Ordered (LPSO) Structure", which features synchronization with respect to chemical and stacking modulations (Fig. 1). The synchronized LPSO structure has great potential to exhibit many advantageous material properties including high strength. However, much remains to be learned concerning the fundamentals of this structure.

To establish a new innovative research area of synchronized LPSO structure, (1) determination of its unique crystallography, (2) elucidation of the principles of its formation, and (3) clarification of its strengthening mechanisms will be focal points of our investigations. Furthermore, our efforts will be further devoted to the innovative development of not only ultra-high-strength LPSO-type Mg alloys created in Japan, but also other new lightweight structural materials.

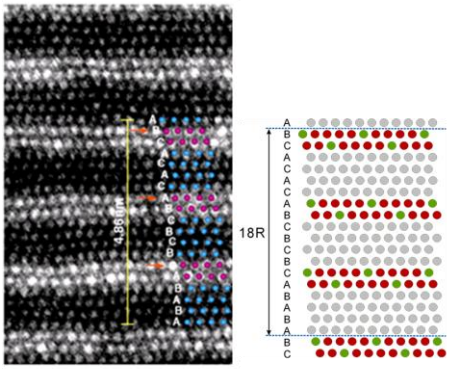

Figure 1 Synchronized LPSO structure (18R) observed in the $Mg_{97}Zn_1Y_2$ alloy

【Content of the Research Project】

The following three research themes will be pursued through nine planned tasks and also ones invited publicly from the 2012 fiscal year.

A01: Elucidation of LPSO structural science by determination of the atomic arrangement

A02: Design of chemical and stacking modulations in LPSO structure through clarification of its formation mechanisms

A03: Study of strengthening mechanisms and deformation dynamics in LPSO structure based on microanalyses and computational mechanics

【Expected Research Achievements and Scientific Significance】

(1) The development of ultra-high strength LPSO-type Mg alloy created in Japan can be put to practical use, which will make great contributions toward solutions to environmental and energy problems.

(2) The elucidation of the formation mechanisms will not only lead to innovative developments of other new lightweight structural materials such as titanium alloys strengthened by the synchronized LPSO structure, but will also help establish new fields of materials science concerning long period structures.

(3) Gaining and understanding of the strengthening mechanisms can give rise to a new concept of materials strengthening, namely, "kink band strengthening." The kink deformation mechanism may be applied to not only the development of high strength alloys but also to the development of highly ductile ceramic materials.

【Key Words】

Long-period stacking ordered structure; staking fault; structural modulation; chemical modulation; kink deformation; kink band strengthening; disclination

【Term of Project】 FY2011-2015

【Budget Allocation】 1,152,300,000 JPY

【Homepage Address and Contact Information】

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