New polytypes of LPSO structures in Mg-Zn/Co-Y alloys

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Long period stacking ordered (LPSO) structures in magnesium alloys have attracted great research interest for their considerable strengthening and toughening effect, as well as the novel structural characteristics. Each LPSO structure is known to contain either AB"C"A or AB"C building block with 1-4 Mg layers sandwiched between them. By atomic-scale high-angle annular dark field scanning transmission electron microscopy, we find the co-existence of AB"C"A and AB"C building blocks in a single LPSO structure of the as-cast $Mg_{92}Co_2Y_6$ (at.%) alloy, leading to the formation of six new polytypes of the LPSO structures determined as 29H, 51R, 60H, 72R, 102R, and 192R[1]. Meanwhile, 654R formed via ordered intergrowth of 15R and 12H LPSO phaseis observed in an $Mg_{88}Co_5Y_7$ (at.%) as-cast alloy[2]. Besides previously reported 18R and 14H, eight new polytypes with complex structure in a near-equilibrium $Mg_{97}Zn_1Y_2$ alloy are analyzed and determined as 60R, 78R, 26H, 96R, 38H, 40H, 108H and 246R, which feature AB"C"A building blocks with two and three Mg layers sandwiched between them[3]. A new notation is introduced to briefly describe the stacking sequences of LPSO structures in magnesium alloys and to easily determine their Bravias lattices and space groups. Rules are as follow: AB"C"A (and/or AB"C) building blocks are defined as F-block (T-block) and denoted as F (T); bar sign presents opposite shear direction of the block; the integer number *n* means the number of Mg layers; the subscript number presents the number of sub unit cells.

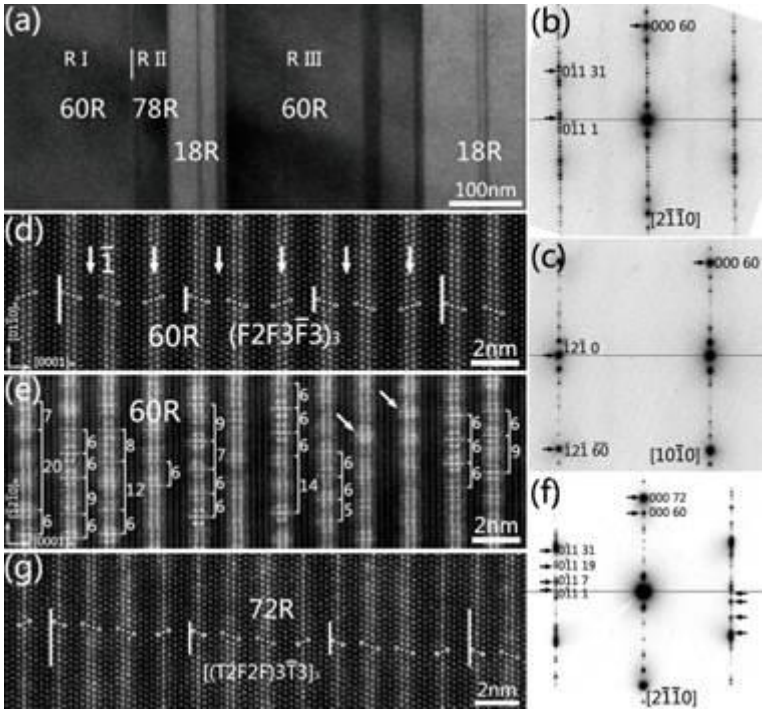

Fig. 1 (a) Low-magnification TEM image showing the coexistence of 18R, 60R and 78R structures in the near-equilibrium $Mg_{97}Zn_1Y_2$ as-cast alloy. SAED patterns of the 60R structure obtained along the (b) [$2\bar{1}\bar{1}0$] and (c) [$10\bar{1}0$] zone axis. Atomic-resolution HAADF-STEM images of60R structure viewed along the(d) [$2\bar{1}\bar{1}0$] and (e) [$10\bar{1}0$] zone axis, where the distance between neighboring Zn_6Y_8X(Mg, Zn, Y) clusters are highlighted. (f) SAED pattern of the 72R structure in the as-cast $Mg_{92}Co_2Y_6$ alloyobtained along [$2\bar{1}\bar{1}0$] direction. (g) Atomic-resolution HAADF-STEM image of 72R structure viewed along [$2\bar{1}\bar{1}0$] zone axis.

References:

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