Direct observation for intergrowth structures in $REAlB_4$ (RE = Tm and Yb) compounds

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Recently, the $REAlB_4$ (RE = Tm and Yb) compound has accumulated many researchers' attention, because of interesting fundamental problems in physics and chemistry. In the present study, we investigated the intergrown structure of the α- and β-type phases in $REAlB_4$ crystals by means of HREM observations. It is significantly important for understanding transport and magnetic properties to reveal the nanostructures of both phases in the real space.

The crystallographic relationship between the α- and β-phases is (010)α || (1-10)β and [001]α || [001]β as shown in Fig. 1. High-resolution images of the β-type $TmAlB_4$ polycrystalline sample [1,2] and β-type $YbAlB_4$ single crystal sample [3] clearly exhibit intergrown lamellar structures in the matrix. The lamellar structures can be characterized by a tiling of deformed hexagons, which are a common structure unit in the α- and β-type structures [4]. It is reasonable to consider that such intergrowth nanostructures can have influence on the appearance or absence of physical and chemical features.

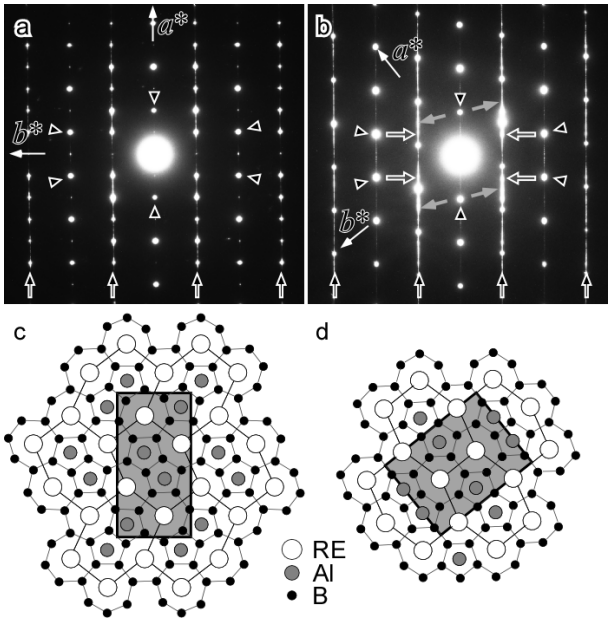

Fig. 1: Electron diffraction patterns of the (a) α- and (b) β-type phases $YbAlB_4$ single crystals taken along the [001] direction, and projected atomic arrangements of (c) α- and (d) β-type phase. Horizontal and tilted gray arrows in (b) indicate diffraction spots from the α-type phase, and twin related β-type domains, respectively.

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