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TEM verification of the <111>-type 4-arm multi-junction in [001]-Mo single crystals

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Disclaimer

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Objective

To investigate and verify the formation of <111>-type 4-arm multi-junction by the dislocation reaction of 1/2[111] [**b1**] + 1/2[$\bar{1}1\bar{1}$] [**b2**] + 1/2[$\bar{1}\bar{1}1$] [**b3**] = 1/2[$\bar{1}11$] [**b4**], which has recently been discovered through computer simulations conducted by Vasily Bulatov and his colleagues.

Approach

TEM foils were sliced parallel to the ($\bar{1}01$) plane of a compress-deformed [001]-Mo single crystal (total strain: 1%, strain rate: 1.0 s^{-1}), the foil thinning procedure was completed using twin-jet electro-polishing techniques. A **g** (reflection vector) • **b** (Burgers vector) experiment, i.e. the **g** • **b** = 0 contrast invisible criterion, was employed to verify the Burgers vector of individual dislocation.

Technical highlight

A typical result of the **g** • **b** experiment for verifying the <111>-type 4-arm junction is shown in Figs. 1 – 3. The first two arms of **b1** and **b2** dislocations can be unambiguously identified (Fig. 1) using two reflection vectors: [$\bar{1}2\bar{1}$] and [121], which are available in the [$\bar{1}01$]-zone diffraction pattern. Although the contrast of **b3** and **b4** dislocations become invisible using the [101] reflection vector available in the [$\bar{1}01$]-zone pattern [Fig. 2 (b)], they can not be individually distinguished. In order to identify **b3** and **b4** dislocations individually, the [$\bar{2}01$]-zone diffraction pattern has been used. Here, **b3** and **b4** dislocations can be identified unambiguously (Fig. 3) using reflection vectors: [$\bar{1}\bar{1}\bar{2}$] and [$1\bar{1}2$], which are available in the [$\bar{2}01$]-zone diffraction pattern.

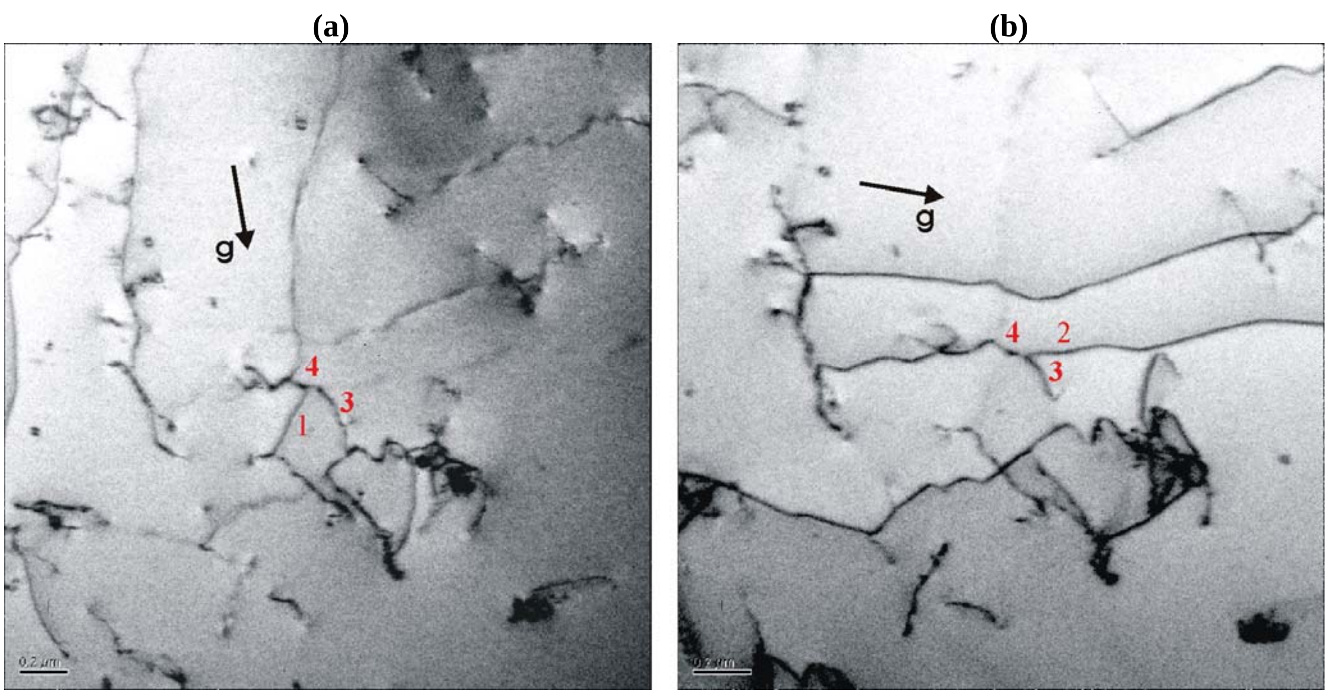

Fig. 1. (a) **Z** (zone axis) ≈ [$\bar{1}01$], **g** = [121], 1/2[$1\bar{1}1$] [**b2**] is invisible; (b) **Z** ≈ [$\bar{1}01$], **g** = [$\bar{1}2\bar{1}$], 1/2[111] [**b1**] is invisible.

(a) (b)

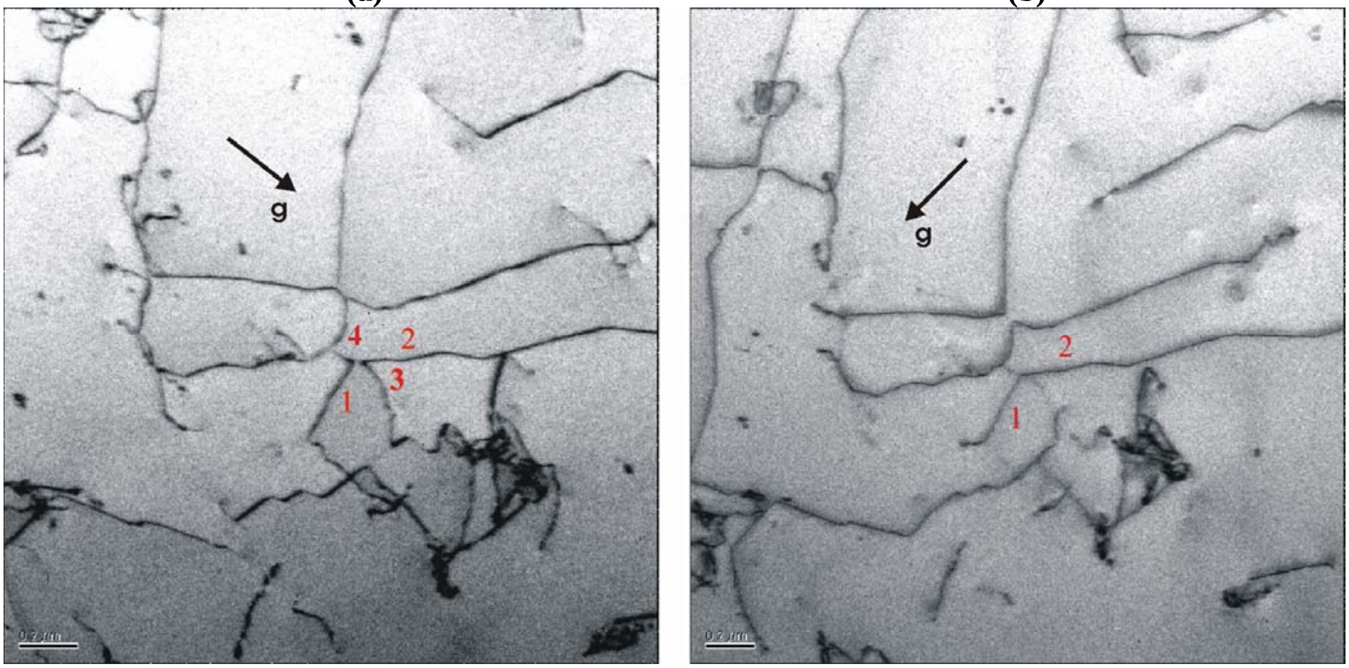

Fig.2. (a) **Z** $\approx [\bar{1}01]$, **g** = [020], dislocations of all four burgers vectors are visible; (b) **Z** $\approx [\bar{1}01]$, **g** = [101], both 1/2[$\bar{1}\bar{1}1$] [**b3**] and 1/2[$\bar{1}11$] [**b4**] are invisible (or have a faint contrast).

(a) (b)

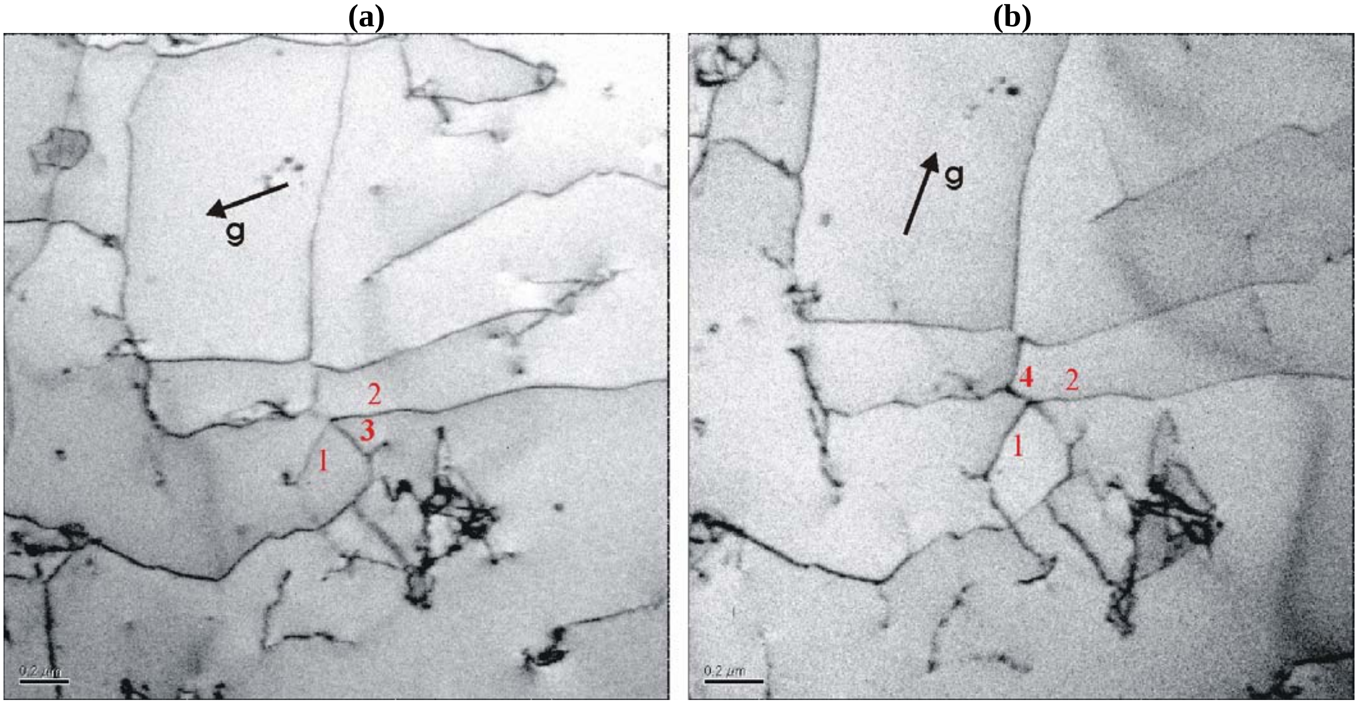

Fig. 3. (a) **Z** $\approx [\bar{2}01]$, **g** = [$1\bar{1}2$], 1/2[$\bar{1}11$] [**b4**] is invisible; (b) **g** = [$\bar{1}\bar{1}\bar{2}$], 1/2[$\bar{1}\bar{1}1$] [**b3**] is invisible (or has a faint contrast).