

## Description of Additional Supplementary Files

**Supplementary Movie 1** Reversible deformation of an Au bicrystal containing a  $13.5^\circ [1\bar{1}0]$  LAGB. The GB migration was mediated by the collective motion of dissociated GB dislocations. The movie was speeded up by 5 times.

**Supplementary Movie 2** Reversible migration of a  $13.5^\circ [1\bar{1}0]$  LAGB in Au bicrystal reproduced in MD simulation at 300 K under the shear velocity of  $1 \text{ m s}^{-1}$ .

**Supplementary Movie 3** Real-time stress-strain curve corresponding to the reversible migration of the  $13.5^\circ [1\bar{1}0]$  LAGB in an Au bicrystal during shear loading cycle.

**Supplementary Movie 4** Long-term reversible deformation of an Au bicrystal for 500 cycles in MD simulation.

**Supplementary Movie 5** Reversible deformation of an Au bicrystal consisting a  $18^\circ [1\bar{1}0]$  GB under different strain rates. The movie was speeded up by 5 times for deformations under the strain rates of  $0.006 \text{ s}^{-1}$  and  $0.06 \text{ s}^{-1}$ .