Supporting information

Grain boundary phases in bcc metals

T. Frolov,¹ W. Setyawan,² R. J. Kurtz,² J. Marian,³ A. R. Oganov,^{4, *} R. E. Rudd,¹ and Q. Zhu⁵

¹Lawrence Livermore National Laboratory, Livermore, California 94550, USA
²Pacific Northwest National Laboratory,
P. O. Box 999, Richland, Washington 99352, USA
³Department of Materials Science and Engineering, University of California Los Angeles, Los Angeles, California 90095, USA
⁴Stony Brook University, Stony Brook, New York 11794, USA
⁵Department of Physics and Astronomy, High Pressure Science and Engineering Center, University of Nevada, Las Vegas, Nevada 89154, USA



Fig. S1. Results of the evolutionary search for $\Sigma 5(001)$ (210)-twist and (310)-twist boundaries in Mo (a and b) and Ta (c and d). GB energy is plotted as a function of the number of atoms [n]. The arrows indicate different GB phases at [n]=1/5 and [n]=2/5.

 ^{*} Current address: Skolkovo Institute of Science and Technology, Skolkovo Innovation Center, 3 Nobel St., Moscow 143026, Russia



Fig. S2. Lowest energy structures at [n]=1/5 and [n]=2/5 of the $\Sigma 5(001)$ (210)-twist boundary predicted by the evolutionary search in W, Mo and Ta.