Phase transition and nanomechanical properties of refractory high-entropy alloy thin films: effects of co-sputtering Mo and W to a TiZrHfNbTa system

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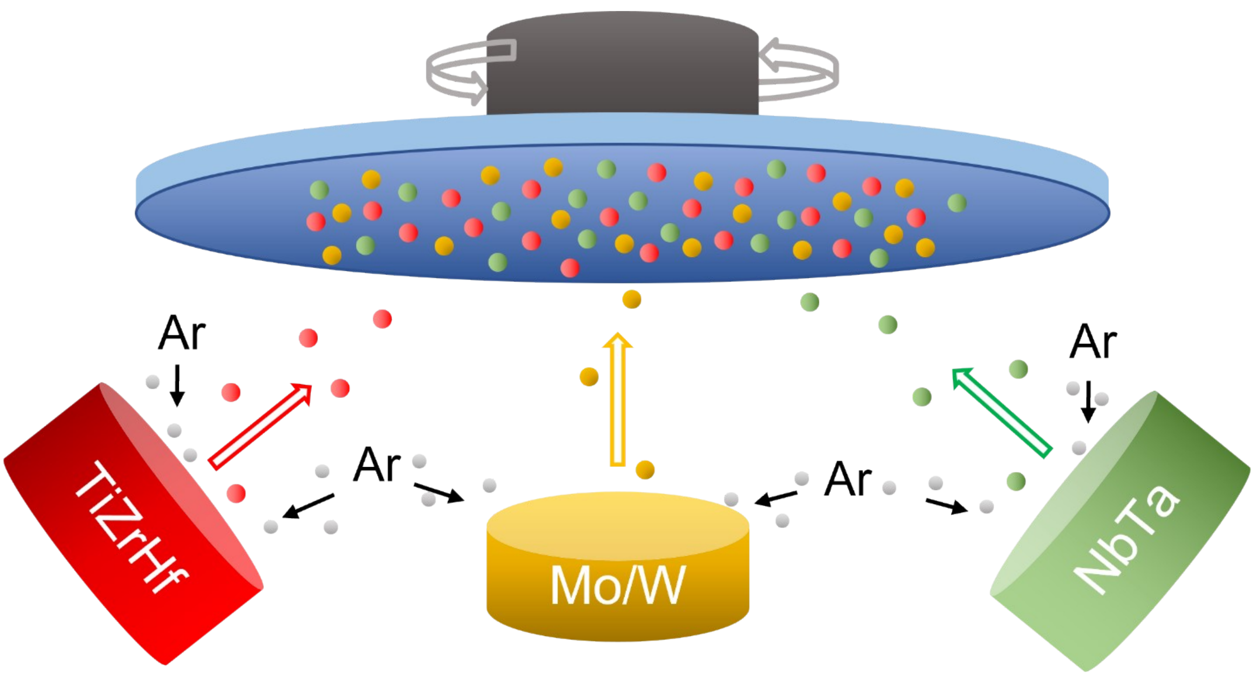

Fig. S1 Schematics of DC magnetron co-sputtering fabrication of TiZrHfNbTa+Mo/W samples

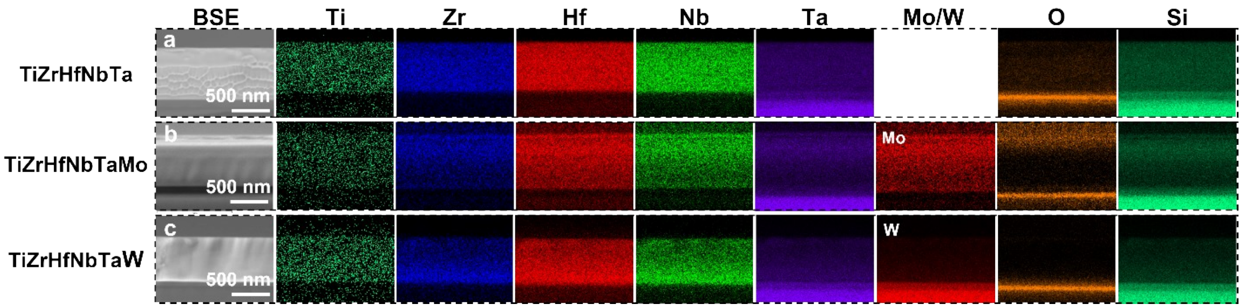

Fig. S2 EDS results of the cross-sections of TiZrHfNbTa, TiZrHfNbTaMo, and TiZrHfNbTaW. To minimize the interaction volume of the electron, a low voltage (5 kV) was used for characterization: the O signal on TiZrHfNbTaMo surface results from the extra signal from the tilted area; the signal from Ti (Kα 4.508 keV) can not be fully excited; the signals from Ta (Mα 1.709 keV) / W (Mα 1.774 keV) / Si (Kα 1.739 keV) overlap with each other due to their close ionization energies.

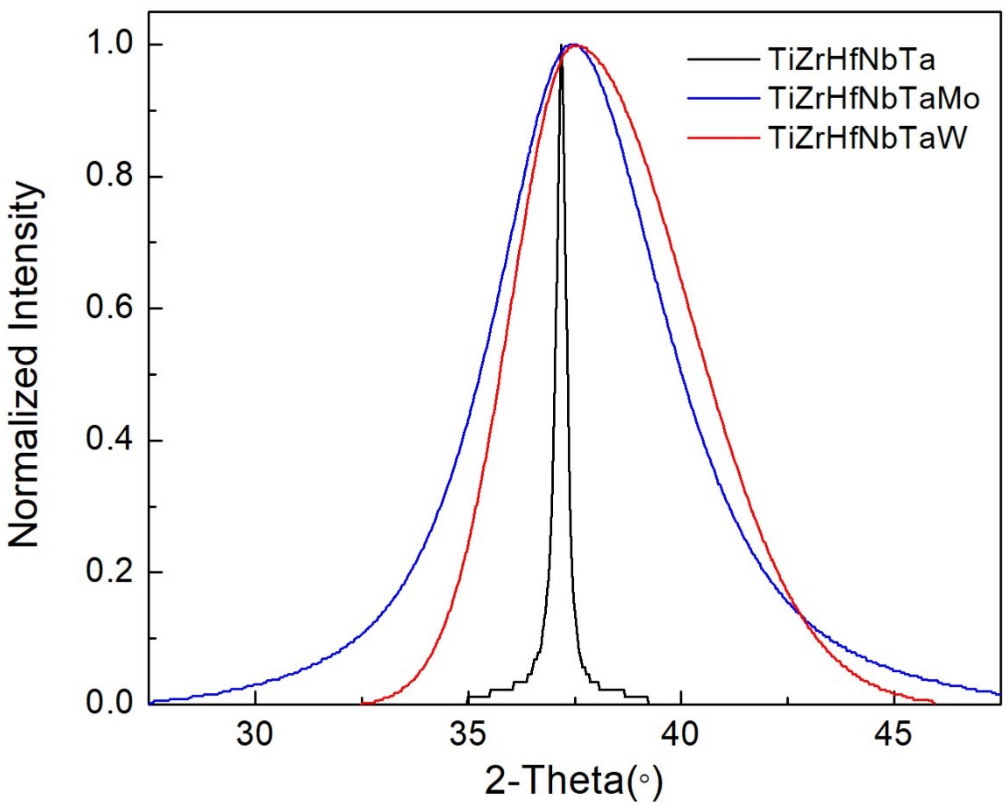

Fig. S3 The XRD peaks of TiZrHfNbTa, TiZrHfNbTaMo, and TiZrHfNbTaW after background subtraction, Bigaussian fitting, and normalization

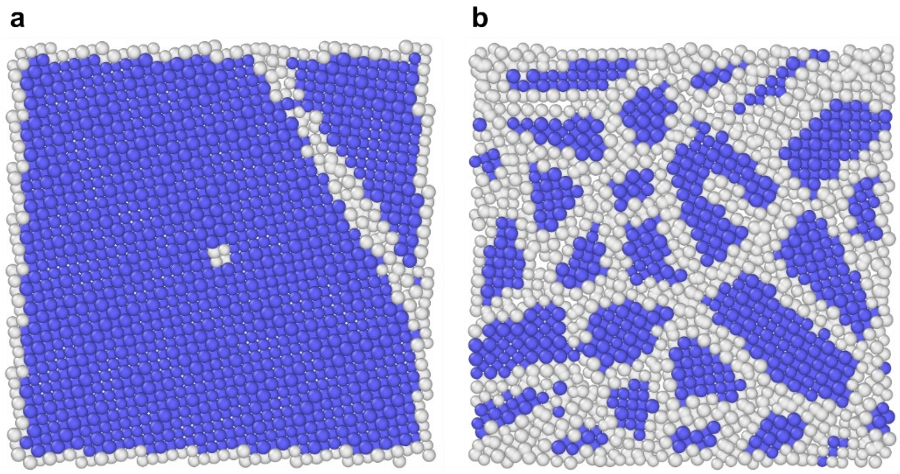

Fig. S4 Grain distribution of (a) nanocrystalline and (b) amorphous materials shown in Fig. 7.

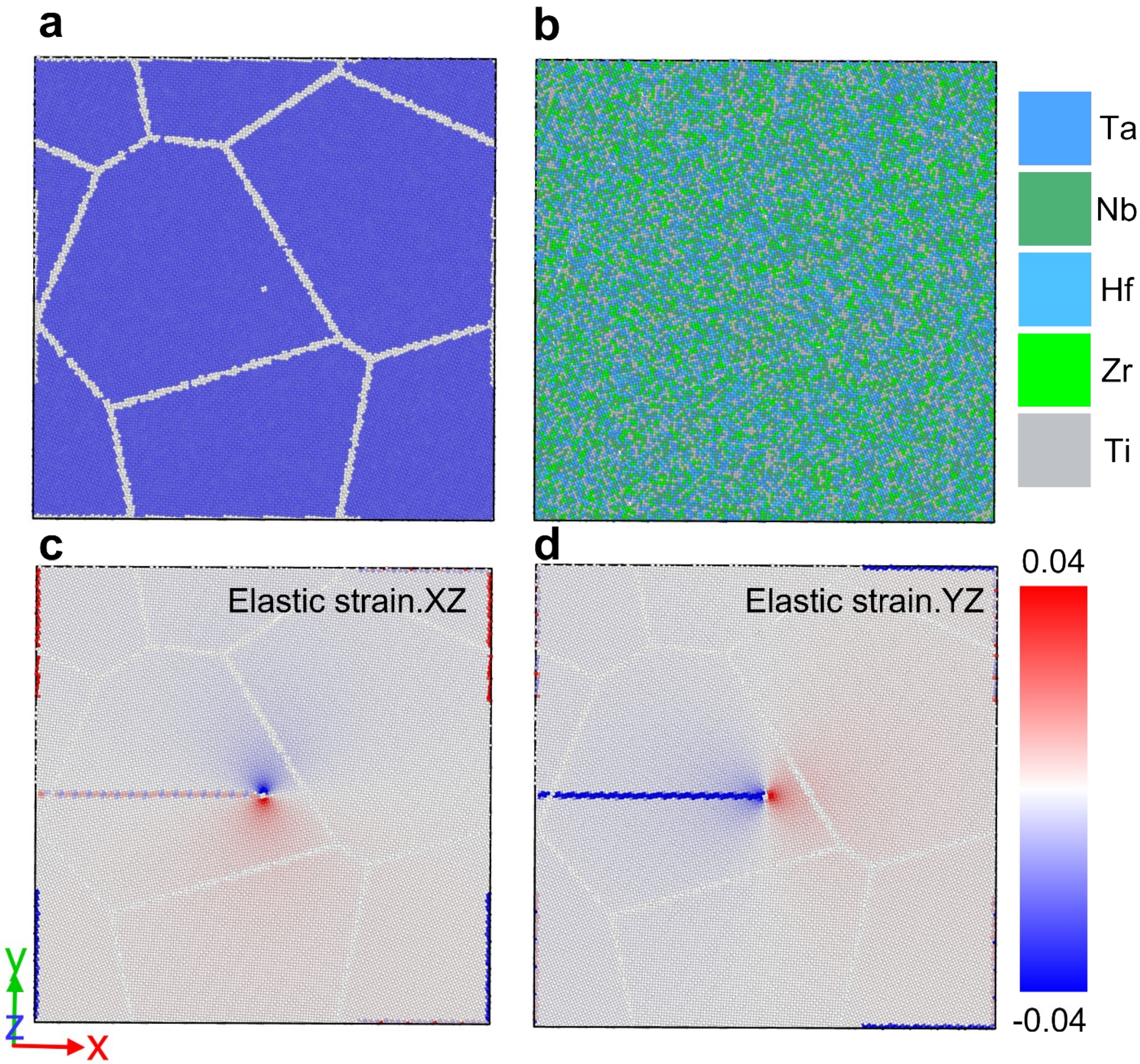

Fig. S5 (a) Grain, (b) element, and (c,d) elastic strain distributions of a nanocrystalline material after introducing one 1/2(111) screw dislocation