

## Supplemental Document:

### Enhanced hardening and damage-tolerance of nanotwinned medium entropy alloy CoCrNi coatings deposited by magnetron sputtering

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Periodic fringes of 0.8~1.3 nm in spacing can be identified in the complementary bright-field and dark-field TEM images as shown in Figure 1 a and b. Fig. 1c shows a SAED pattern from this coating. The pattern is very complex and exhibits a number of rod-like features. The rods are tangential to the {111} ring in Fig.6c, that is, the distance between a pair of rods is the same as the diameter of the {111} ring. The angle between the normal vectors of the two groups of planar defects, as shown in Fig. 1b, is  $\sim 75^\circ$ .

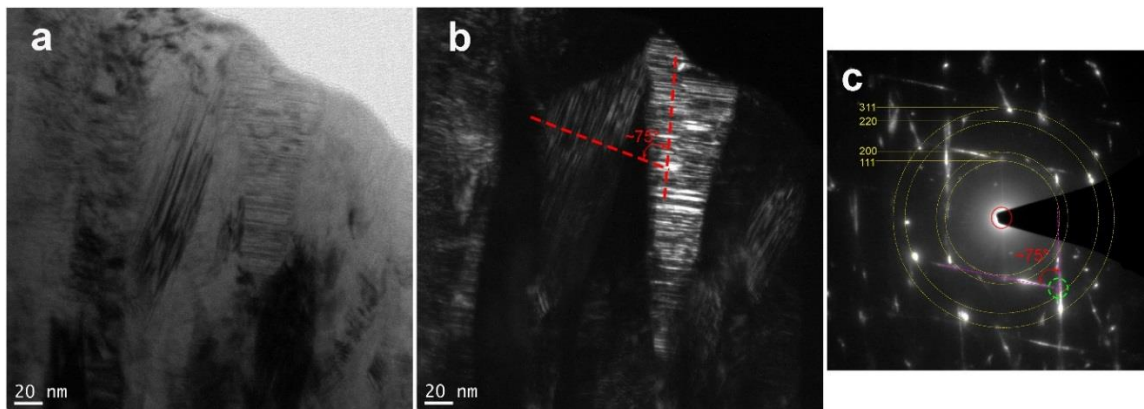


Fig. 1 High magnification (a) bright field and (b) dark field TEM images of CoCrNi coating, showing the planar defects; (c)SAED pattern containing the area in (a) and (b). The solid red and dashed green circled areas in (c) were selected for bright field and dark field imaging, respectively.

A high-resolution TEM (HRTEM) image of coating CoCrNi is shown in Fig.2. The inverse Fourier fast transform (IFFT) figure from the red marked region is shown as an inset. The blue line inserted in the inset marks the  $(1\bar{1}1)$  twin plane. The interplanar spacing measured from the IFFT figure is 0.206 nm, which is in good agreement with the  $d$ -spacing of the (111) planes, 0.205 nm.

Fig. 3 shows cross-sectional focused ion beam images the CoCrNi coatings before and after deformation. In Fig. 3a, a wetting Ti layer of 0.1 $\mu\text{m}$  in thickness is readily visible. On top of it, the CoCrNi coating of 1  $\mu\text{m}$  in thickness with columnar grains can be observed. Fig. 3b shows the cross-section of deformed coating under a maximum load of 500 mN with a spherical indenter (radius 5  $\mu\text{m}$ ). Although severe plastic deformation of both coating and substrate can be seen, no delamination between the coating and the substrate can be observed. No cracks could be observed in the coating, suggesting excellent damage-tolerance capability of the CoCrNi coating.

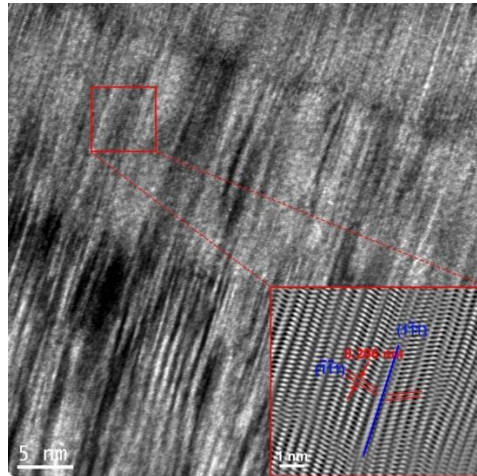


Fig. 2 HRTEM image of coating CoCrNi in [011] projection. The inset is the inverse fast Fourier transform (IFFT) figure of the marked area, showing the symmetric lattices of the twinning structure

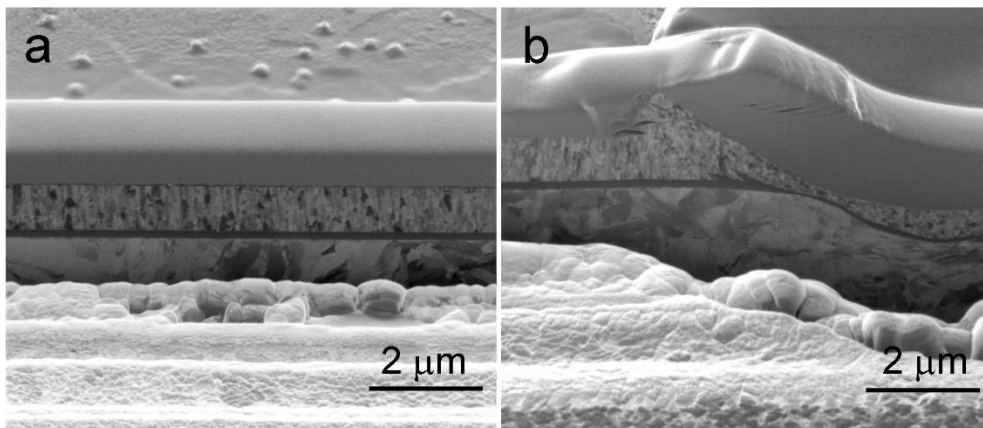


Fig. 3 Cross-sectional focused ion beam images of the 1 μm CoCrNi coating (a) before and (b) after deformation under 500 mN load with a spherical indenter (radius: 5 μm).