Supporting Information

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Synergistic effects of passivation treatment and nano-electrodeposition technologies on corrosion protection performance of electrogalvanized steel

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Fig. S1 Cross-sectional morphologies of the coarse-grained (a) and nanocrystalline (b) zinc coatings.

Fig. S2 gives the surface morphologies and binary images of passive film on coarse-grained and nanocrystalline zinc coatings after potentiodynamic polarization test. In the binary images of passive film on coarse-grained zinc coating (Fig. S2b), the black regions correspond to the residual passive films of the coating after corrosion resistance test. In the binary images of passive film on nanocrystalline zinc coating (Fig. S2d), the white regions correspond to the residual passive films of the coating after corrosion resistance test. In the binary images of passive films of the coating after corrosion resistance test. The residual areas of passive film on coarse-grained and nanocrystalline zinc coatings after polarization test are 0.023 and 0.042 mm², and the total areas of passive films on coarse-grained and nanocrystalline zinc coatings are both 0.078 mm² by the ImageJ2x software. The defect rates (η) of passive film on coarse-grained and nanocrystalline zinc coatings are calculated by the following equation:

$$\eta = \frac{S_{total} - S_{left}}{S_{total}} \times 100\% \tag{1}$$

Where S_{total} and S_{left} are the total area and the residual area of the passive film before and after potentiodynamic polarization test, respectively. The η of passive film on the surface of coarse-grained and nanocrystalline zinc coatings are approximately 70.51% and 46.15%, respectively.



Fig. S2 Suface FESEM images of passive film on coarse-grained (a) and nanocrystalline (c) zinc coatings after potentiodynamic polarization test, as well as those binary images (b - coarse-grained zinc and d - nanocrystalline zinc).



Fig. S3 FESEM images with different magnifications of passive film on coarse-grained zinc coating: (a - 10000 times; b - 50000 times).



Fig. S4 FESEM images of coarse-grained zinc coating in thicknee direction.



Fig. S5 Surface FESEM image of passive film on nanocrystalline zinc coating under high magnification 50000 times.