

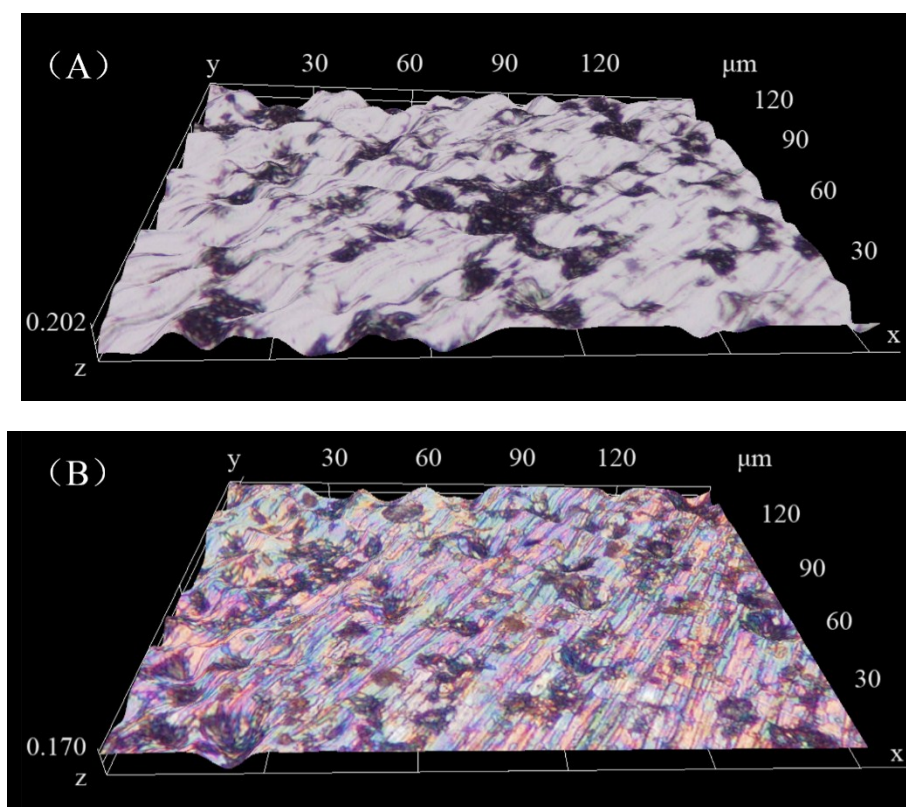
# Electronic Supplementary Information

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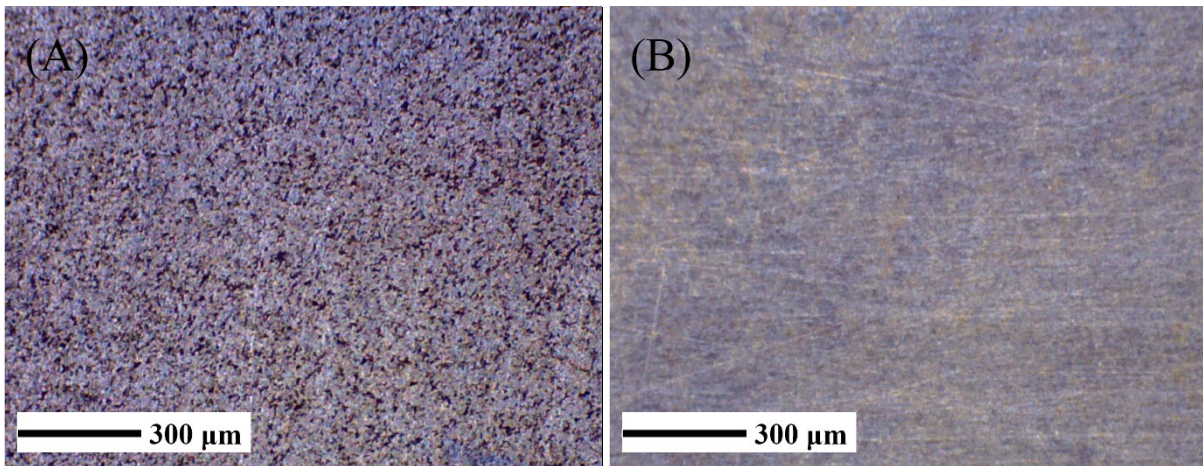
The surface roughness of the bare NdFeB and NdFeB with 3-minutes-dipped AS film were observed by Hirox KH7700 Digital microscope. The NdFeB was polished by 1500# sand paper, and there existed some defects caused by the stripped  $\text{Nd}_2\text{Fe}_{14}\text{B}$  phase. The defects were also where the pitting occurred. From the digital microscope images (S 1), the roughness of NdFeB surface decreased with the formation of AS film. As shown in S 1 (A), the peak asperity of the bare NdFeB reached  $0.202\ \mu\text{m}$ . S 1 (B) shows that alumina sol filled some defects on the surface and the peak asperity reduced to  $0.17\ \mu\text{m}$ , which is helpful for preventing pitting. In visible light, the colorful stripes on the surface also demonstrated the formation of alumina conversion film on NdFeB magnets.



**S1.** Digital microscope images of (A) bare NdFeB (B) NdFeB with AS film.

The standard solution with a content of 3.5 wt. % NaCl was chosen as the corrosion medium for determination and comparison of corrosion behavior in the present work. S 2 show the bare NdFeB and NdFeB with AS film immersed in 3.5 wt. % NaCl solution for 12 hours to evaluate the initial

corrosion behaviors. As shown in S 2 (A), there existed many pitting on bare NdFeB. According to the electrochemical characteristics of NdFeB magnets, the pitting occurred from the Nd rich phase, which matched with the pitting position in S 2 (A). Pitting corrosion on NdFeB could cause the  $\text{Nd}_2\text{Fe}_{14}\text{B}$  phase fall out and further damage the magnetic properties. As shown in S 2 (B), the NdFeB was well protected by the AS film. In alumina sol, the Nd rich phase promoted the gel of alumina particles because of its high chemical activity. These results demonstrates that the AS film protects the NdFeB from pitting corrosion.



**S2.** Optical images of (A) bare NdFeB magnets and (B) NdFeB with AS film immersed in 3.5 wt. % NaCl solution for 12 hours