Supplementary Material

**Multilayer MoS2: an effective barrier enhancer and a promising nanofiller for metal protection**

Jing Wang1,3,4, Ning Wang1,3,4,\*, Qianyu Zhao1,3,4, Chengyue Ge1,3,4, Baorong Hou1,3,4,

Guichang Liu2, Wen Sun2,\*, Yiteng Hu1,3,4, Yanli Ning1,3,4

*1* *CAS Key Laboratory of Marine Environmental Corrosion and Bio-fouling. Institute of Oceanology. Chinese Academy of Sciences, No.7 Nanhai Road, Qingdao 266071, PR China.*

*2 Department of Chemical Engineering, School of Chemical Engineering, Dalian University of Technology, No.2 Linggong Road, Dalian 116024, PR China.*

*3 Open Studio for Marine Corrosion and Protection, Qingdao National Laboratory for Marine Science and Technology, Qingdao, 266237, PR China.*

*4 Center for Ocean Mega-Science, Chinese Academy of Sciences, No.7 Nanhai Road,*

*Qingdao 266071, PR China.*

\* Corresponding author.

*Tel./Fax: 1*3808997873

*E-mail address:* wangning@qdio.ac.cn (Ning Wang).

*Tel./Fax:* 86-411-84986047

*E-mail address:* sunw@dlut.edu.cn (Wen Sun).

C:\Users\Lj\Desktop\zqy\7月工作\7.21-4JMST图\s1.tifs1

**Figure S1.** SEM images of starting MoS2 powders (left) and MDNSs (right).

C:\Users\Lj\Desktop\zqy\7月工作\7.21-4JMST图\s2.tifs2

**Figure S2.** EIS spectra of the seven different coatings at 12 hours of immersion, (a) Bode-modulus plots; (b) Bode-phase plots.

The coating porosity, which is one of the most important parameters which influence the corrosion resistance and lifetime of anticorrosive coatings, can be calculated from Tafel polarization data. The porosity in MDNSs/PVB coatings was calculated using the following equation: [58](#_ENREF_58" \o "Patil, 2004 #47413)

 (S1)

where *P* is the total porosity (%), *R*ps the polarization resistance of the bare brass (Ω·cm2), *R*p the measured polarization resistance of coated brass (Ω·cm2), Δ*E*corr the difference between corrosion potentials (mV) and *b*a the anodic Tafel slope for bare brass (mV/decade). The Tafel polarization data of bare brass were collected after 4 months of immersion (the polarization potential range between *E*OCP−300 and *E*OCP+300 mV at a scan rate of 1 mV/s in aqueous solution of 3.5 wt.% NaCl). Parameters for bare brass is also presented in Table S1. The porosity in MDNSs/PVB0 coating (being immersed for 4 months) was found to be ∼7.25×10-3%. As can be seen from Table S1, the porosity of MDNSs/ PVB coatings decreases with increasing MDNSs loading in the coating matrices. Remarkably, the porosity in coatings decreases significantly to an extremely small value, 9.35×10-21%, when the MDNSs loading is increased to 1.0 wt.%. This suggests that the defects of MDNSs/ PVB0 coatings can be significantly inhibited due to the incorporation of MDNSs nanofillers, which agrees very well with the SEM analyses.

In order to display effect of the MDNSs on coating modification in a visual way, a parameter which represents enhanced corrosion protection efficiency (*η*ecp) was defined by the following equation:

 (S2)

where, *R*corr,i is the corrosion current density of MDNSs/PVB coatings (A/cm2), *R*corr is the corrosion current density of blank coating sample (A/cm2).

**Table S1.** Fitting results of Tafel polarization measurements.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **MDNSs content** | **Electrochemical measurements** | | | | | ***R*corr**  **(mm/year)** | ***η*ecp (%)** | **Coating Thickness (μm)** | ***P*(%)** |
| *E*corr (mV) | *b*a(mV/  decade | *b*c(mV/  decade | *I*corr (μA/cm2) | *R*p  (Ω·cm2) |
| Bare brass | -285.1 | 28.5 | -327.3 | 8.69×100 | 1.31×103 | 3.39×10-2 | - | - | - |
| MDNSs/SR0 | -284.9 | 222.4 | -168.7 | 2.34×100 | 1.78×107 | 2.75×10-2 | - | 54.7 | 7.25×10-03 |
| MDNSs/SR0.1 | -33.98 | 402.3 | -388.8 | 3.12×10-4 | 2.75×1011 | 3.66×10-6 | 100 | 51.8 | 7.36×10-16 |
| MDNSs/SR0.2 | -30.02 | 304.9 | -498.3 | 1.70×10-4 | 4.48×1011 | 1.99×10-6 | 100 | 52.1 | 3.03×10-16 |
| MDNSs/SR0.3 | -25.1 | 498.5 | -805.8 | 1.18×10-4 | 1.13×1012 | 1.38×10-6 | 100 | 49.4 | 8.72×10-17 |
| MDNSs/SR0.4 | -22.6 | 549.1 | -839.6 | 2.12×10-6 | 6.80×1013 | 2.48×10-8 | 100 | 55.2 | 1.19×10-18 |
| MDNSs/SR0.5 | 2.1 | 693.0 | -894.9 | 1.69×10-6 | 1.00×1014 | 1.99×10-8 | 100 | 53.5 | 1.09×10-19 |
| MDNSs/SR1.0 | 25.5 | 967.1 | -916.3 | 1.15×10-6 | 1.77×1014 | 1.35×10-8 | 100 | 50.2 | 9.35×10-21 |