Experimental

Materials

Magnesium nitrate ($Mg(NO_3)_2 \bullet 6H_2O$), aluminum nitrate ($Al(NO_3)_3 \bullet 9H_2O$), urea, citric acid (CA), ferric chloride ($FeCl_3 \bullet 6H_2O$), ferrous chloride ($FeCl_2 \bullet 4H_2O$) and ammonia ($NH_3 \bullet H_2O$) were purchased from Aladdin Biochemistry and Technology Co. Epoxy resin (CYD-014) and its curing agent (P54) were purchased from Baling Chemical (China) Co. Q235 carbon steel plates were purchased from Biuged in Guangzhou Province, (China) Co. The deionized water was produced by the laboratory. All the chemical reagents were not purified.

Characterization and performance test

The structure and morphology of the microspheres were examined using the X-ray diffractometer (XRD, Holland EMPYREAN), scanning electron microscopy (SEM, TESCAN MIRA4 LMH), and transmission electron microscopy (TEM, JEOL, JEM-2100). The surface functional group information of the samples was measured by a Fourier transform spectrophotometer (FT-IR, America Thermo Scientific Nicolet iS50) using the standard KBr disk method. X-ray photoelectron spectroscopy (XPS) measurements were used in analyzing the valence states of elements. Thermo Scientific K-Alpha, USA using monochromatized Al Ka excitation was used.

The microwave absorption of the obtained samples was investigated in the frequency range of 2-18 GHz by Agilent E5071C vector network analyzer through the coaxial-line method. The sample was mixed with paraffin (weight ratio 1:1), and pressed into a ring with an inner diameter of 3.04 mm and an outer diameter of 7.00 mm. Finally, according to the transmission line theory, the RL characteristics of materials with different thicknesses were simulated.

The anti-corrosion properties of the coatings were investigated by electrochemical impedance spectroscopy (EIS) in 3.5% NaCl aqueous solution. The electrochemical measurements were conducted in a traditional three-electrode system with a platinum sheet counter electrode, a saturated calomel reference electrode and a working electrode (bare or coated steel substrate with an exposed area of 1 cm2). EIS measurements were performed at different immersion times at sinusoidal voltages in the frequency range of 100 kHz-10 mHz and an amplitude of 20 mV. All impedance measurements were performed in a Faraday cage to minimize external interference and the experimental data were fitted using ZsimDemo software.

Salt spray test was carried out on the Salt spray test chamber (BGD881, Biuged, Guangzhou) with a salt concentration of 5%, and the scratched samples were exposed to salt spray for 144 h.

UV aging was carried out on a UV lamp (18 W, 365 nm wavelength) and the FTIR spectra of the aged samples were recorded after 24 h. The samples produced were cylindrical in shape with a diameter of 10 mm and a thickness of 2 mm.

To test the wear resistance (UMT-2) of the coating, we used a 440 steel ball to apply a load of 2 N to the surface of the coating under test, and then made it reciprocate in a straight line on the same horizontal plane, with a test speed of 40 mm/s, a travelling distance of 10 mm, and a holding time of the load of 1,800 s.

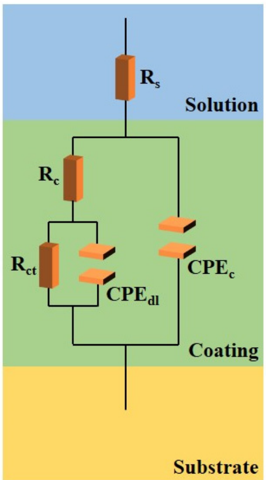

Figure S1. Coating corrosion equivalent circuit diagram.

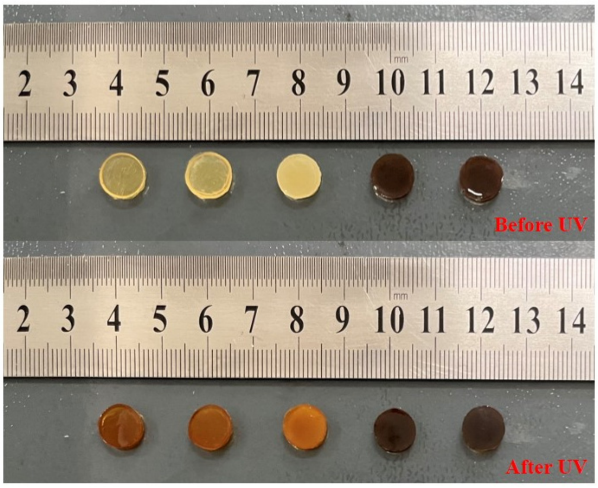

Figure S2. Macroscopic picture of the samples before and after UV irradiation (from left to right, EP, LL/EP, SL/EP and SLF/EP coatings) [49].

Table S1. MA properties of SLF and other previously studied composites

Sample	Filled ratio (wt%)	Minimum RL (dB)	Thickness (mm)	Reference
LDHs/SiC	**50**	**-13.65**	**10**	**[50]**
Fe_3O_4	**75**	**-30.33**	**5.5**	**[51]**
Fe_3O_4/C	**70**	**< -10**	**7**	**[52]**
OA/ Fe_3O_4/PANI	**70**	**-25.40**	**3**	**[53]**
$MgFe_2O_4$	**50**	**-13**	**1.5**	**[54]**
SBS/ SiC/LDHs	**50**	**-9.23**	**8**	**[55]**
SLF	**50**	**-35.75**	**8**	**This Work**

Table S2. Electrochemical impedance spectroscopy data of neat epoxy and nanocomposite coatings.

Samples	*Time*	*CPE_c* $Y_0(ohm^{-1}cm^{-2}s^n)$	*n*	$R_c(ohmcm^2)$	*CPE_dl* $Y_0(ohm^{-1}cm^{-2}s^n)$	*n*	$R_{ct}(ohmcm^2)$
EP	1 d	5.319×10^{-11}	0.989	9.364×10^{9}	1.965×10^{-10}	0.881	6.387×10^{9}
	3 d	6.452×10^{-11}	0.976	1.295×10^{9}	1.073×10^{-9}	0.472	6.573×10^{8}
	5 d	7.068×10^{-11}	0.980	1.949×10^{7}	2.870×10^{-10}	0.601	7.747×10^{8}
	7 d	1.809×10^{-10}	0.800	1.112×10^{7}	6.852×10^{-8}	0.800	2.200×10^{11}
LL	1 d	4.371×10^{-11}	0.984	2.718×10^{10}	1.588×10^{-11}	0.670	8.399×10^{10}
	3 d	2.126×10^{-11}	0.991	1.416×10^{10}	9.863×10^{-11}	0.550	2.797×10^{10}
	5 d	1.791×10^{-11}	0.784	0.01	9.652×10^{-12}	1.000	3.725×10^{8}
	7 d	3.959×10^{-11}	0.915	1.794×10^{8}	2.659×10^{-11}	0.248	0.01
SL	1 d	6.037×10^{-12}	0.384	0.01	4.413×10^{-11}	0.984	1.039×10^{11}
	3 d	6.637×10^{-11}	0.959	2.046×10^{9}	6.53×10^{-10}	0.704	1.485×10^{11}
	5 d	6.355×10^{-11}	0.961	4.306×10^{8}	3.668×10^{-8}	0.289	9.632×10^{12}
	7 d	6.444×10^{-11}	0.800	4.191×10^{8}	3.059×10^{-7}	0.800	0.01
SLF	1 d	2.293×10^{-11}	0.966	7.637	2.402×10^{-11}	0.417	1.358×10^{11}
	3 d	2.204×10^{-11}	0.970	4.469×10^{9}	6.243×10^{-11}	0.576	6.22×10^{10}
	5 d	2.568×10^{-11}	0.965	3.829×10^{9}	2.77×10^{-9}	0.561	2.588×10^{10}
	7 d	4.398×10^{-11}	0.975	1.432×10^{9}	5.692×10^{-11}	0.556	1.677×10^{10}
	10 d	3.461×10^{-11}	0.965	414.7	6.81×10^{-11}	0.334	8.182×10^{9}