

Supplementary information file for:

**Improving the performance of acrylic-epoxy ester hybrid
coatings with phosphate monomers**

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Table S1 Formulation of Vegetable Oil Acid Modified Epoxy Resin

Ingredients	Relative amount (%)
Eleostearic acid (278.43)	2%
Linoleic acid (280.45)	23%
Dibutyltin dilaurate (DBTDL)	0.1%
Epoxy resin E12	30%
Epoxy resin E06	16%
Butyl acetate (BA)	4%
Propylene glycol methyl ether (PM)	22%
n-Butanol	4%
Zinc oxide	0.1%

Table S2 Synthetic formulation of modified acrylic acid hybrid emulsion

Ingredients	Relative amount (%)
70% Epoxy ester (intermediate)	41%
Propylene glycol methyl ether	5.7%
Acrylic acid (AA)	5.2%
2-Ethylhexyl acrylate (2-EHA)	0.82%
Butyl acrylate (BA)	2.45%
Methyl methacrylate (MMA)	27.7%
Styrene (ST)	4.1%
Phosphate ester monomer (HEMAPE)	2%/4%/6%/8%
Chain transfer agent (α -methylstyrene linear dimer)	0.5%
Tert-butyl peroxybenzoate (DTA)	0.75%
Propylene glycol methyl ether	1.63
Propylene glycol methyl ether (PM)	0.016
Triethylamine (industrial grade) (101)	6.62%

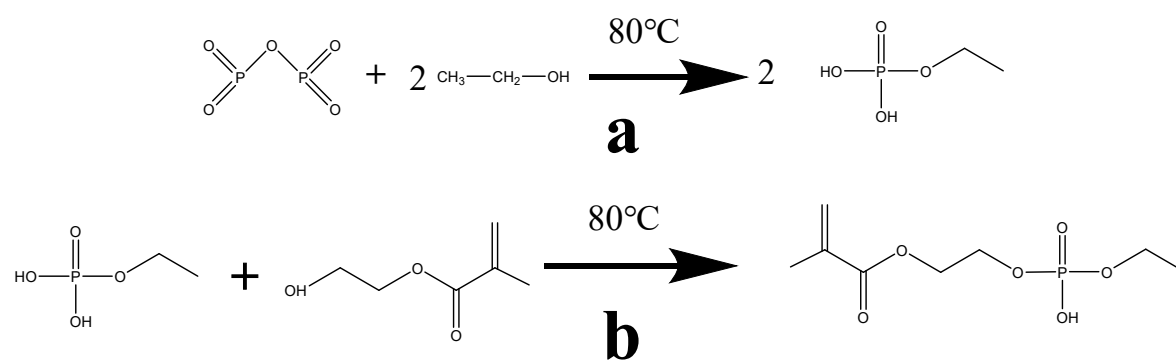


Figure S1 Synthesis of functional phosphate monomers as shown in (a) and (b)

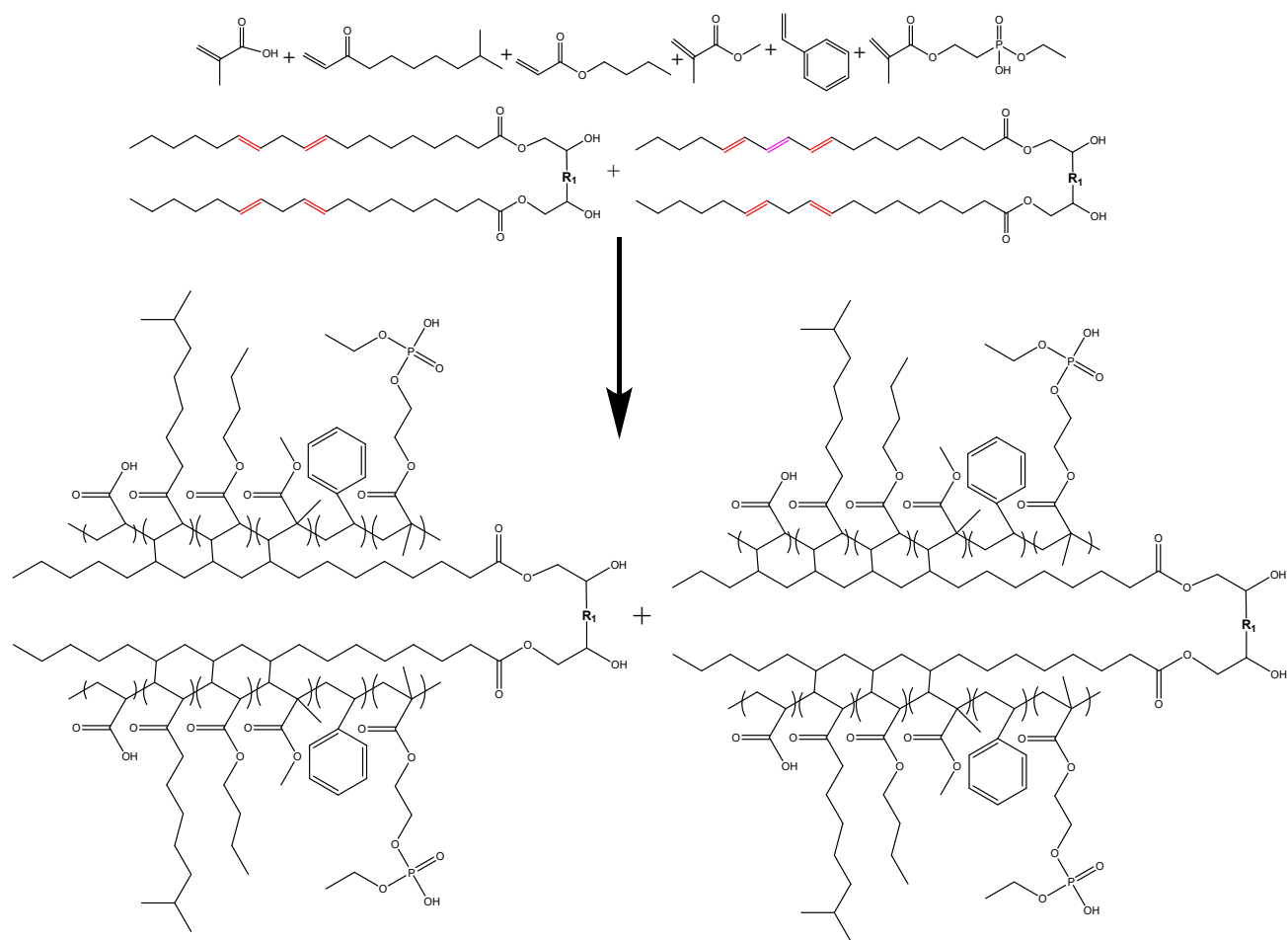


Figure S3 Synthesis of modified waterborne acrylate epoxy ester

1. ^{13}C NMR Test:

As illustrated in Figure S4, ^{13}C NMR showed the signal for tertiary C atoms at 136.08 ppm and 174.29 ppm, indicating the presence of a C=O group of ester. The signal at 126.53 ppm and 18.35 ppm corresponded to CH_2 and CH_3 , respectively.

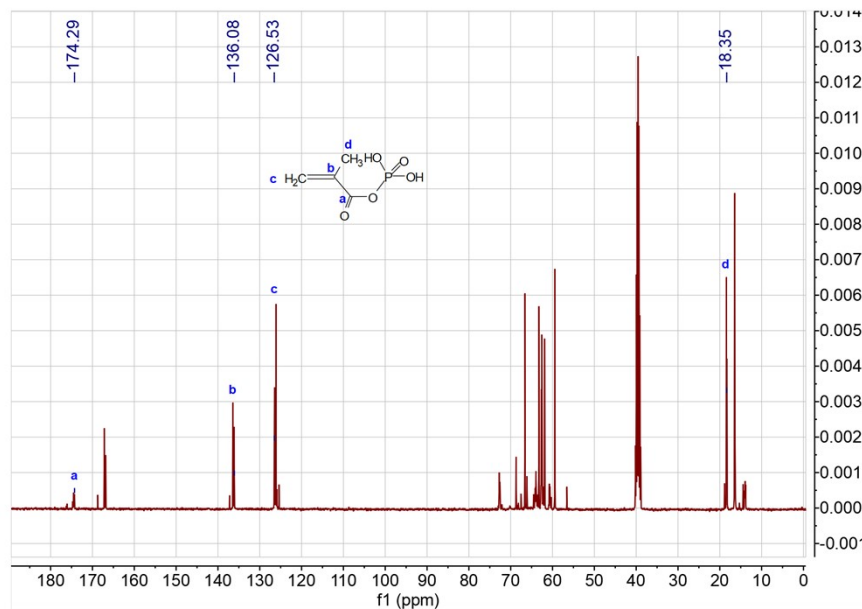


Figure S4 ^{13}C NMR of HEMAPE.

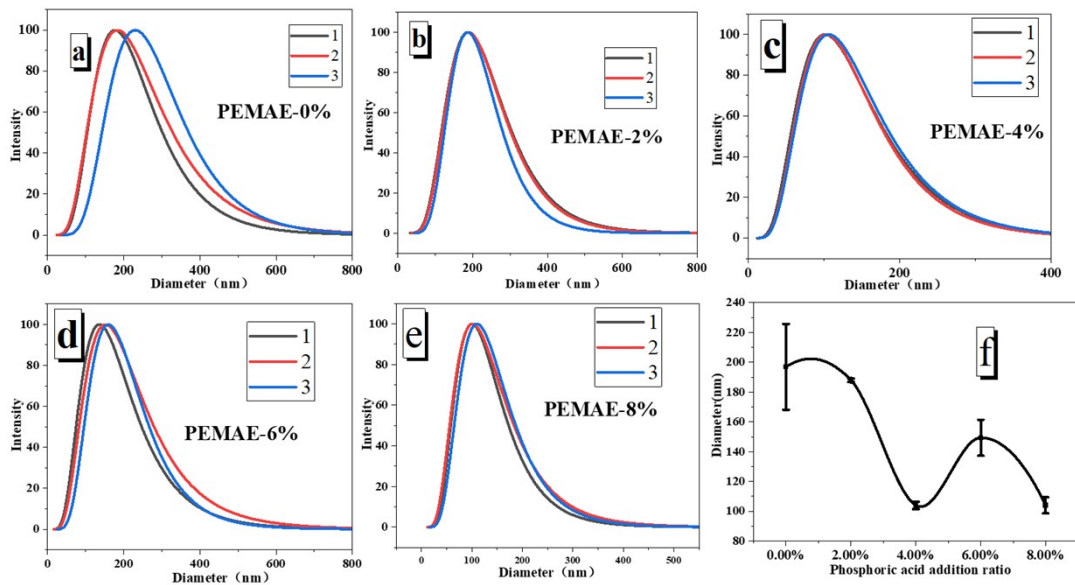


Figure S5 (a) Particle size of HEMAPE modified resin emulsion (a) Cubic average particle size of PEMA-0% (b) Cubic average particle size of PEMA-2% (c) Cubic average particle size of PEMA-4% (d) Cubic average particle size of PEMA-6% (d) Cubic average particle size of PEMA-8%

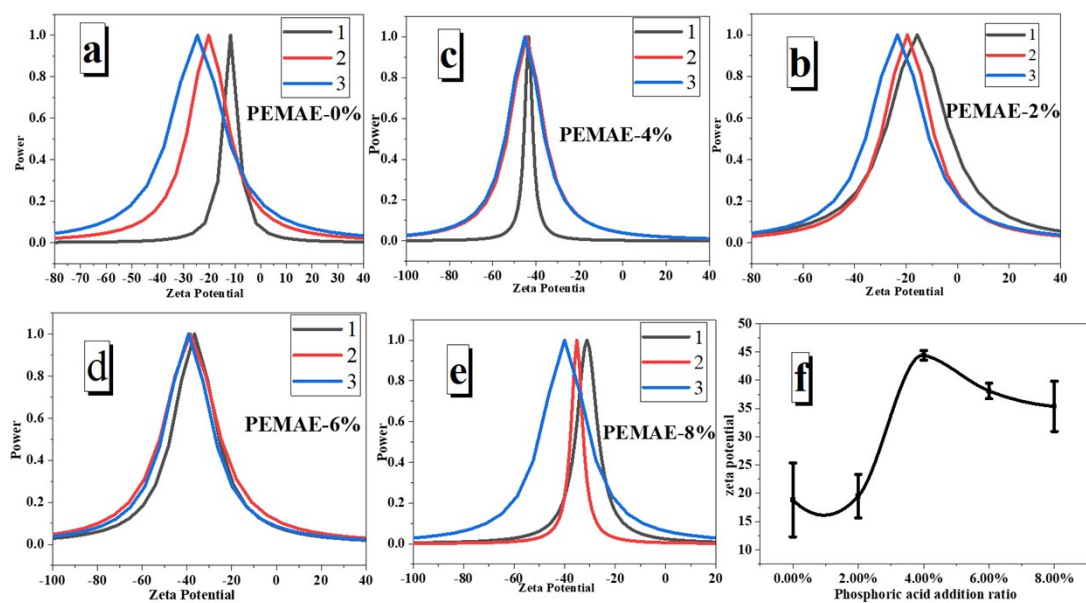


Figure S6 Zeta potential of HEMAPE modified resin emulsion (a) PEMA-0% cubic Zeta potential (b) PEMA-2% cubic Zeta potential (c) PEMA-4% cubic Zeta potential (d) PEMA-6% cubic Zeta potential (d) PEMA-8% cubic Zeta potential (c)

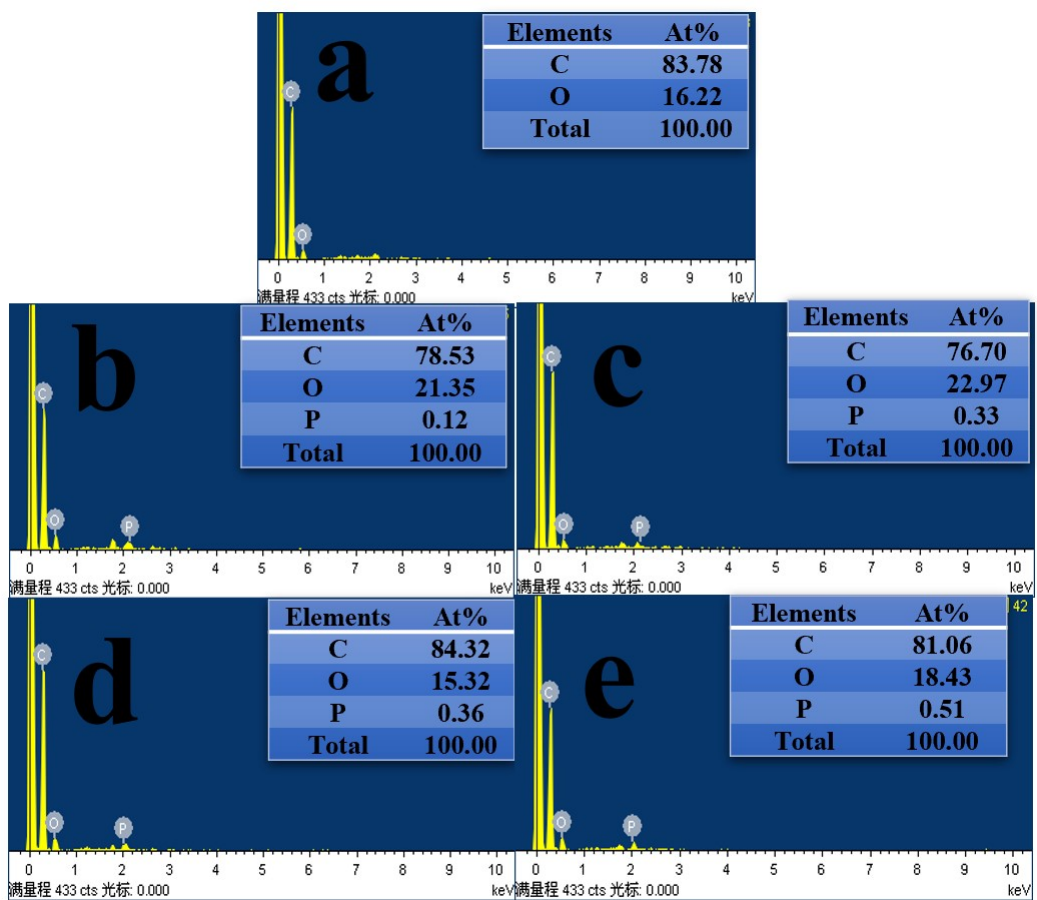


Figure S7 (a)PEWA-0%, (b)PEWA-2% , (c)PEWA-4%, (d)PEWA-6%, (e)PEWA-8% coating elements of EDS analysis.

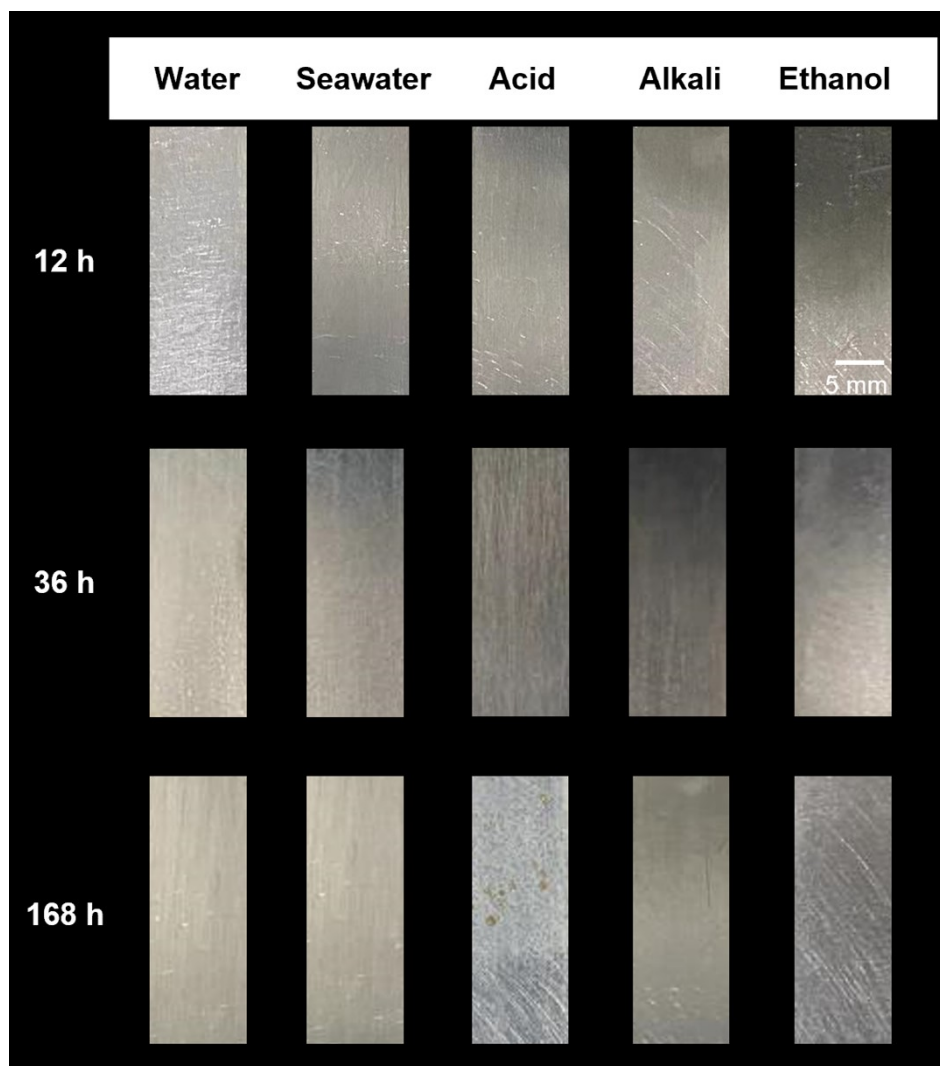


Figure S8 Chemical stability tests of composite coatings in different solvents.

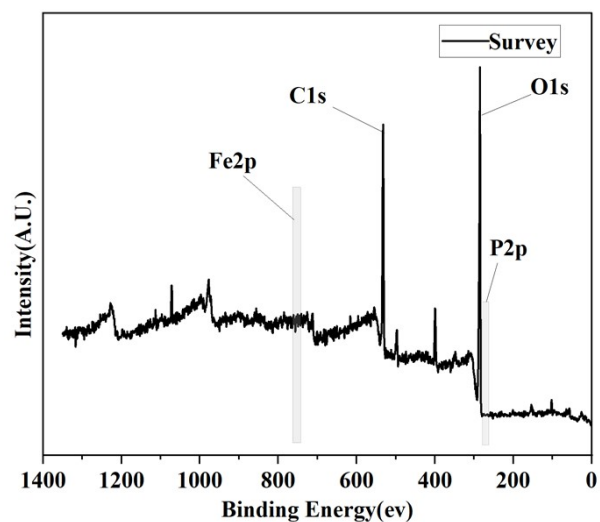


Figure S9 Full XPS spectrum of the adhesion failure surface of the modified epoxy coating.