Supporting information

An Improved Corrosion Resistance of Steel in Ethanol Fuel Blend by Titania

Nanoparticles and Aganonerion Polymorphum Leaf Extract

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Table S1. TNPs – 10 nm average size and weight fraction calculated from XRD pattern.

TNPs phase	Calculated size (nm)	Weight fraction (%)	Average size (nm)
Anatase	8.6	43	0.7
Rutile	10.6	57	9.1

Table S2. Electrochemical impedance measurements of steel immersed in solution containing 0 and 1000 ppm APLE with different concentration of 10 nm TNPs, and 1000 ppm APLE with 30 ppm TNPs of 10, 20, and 30 nm in diameter. (Q_{pro} and R_{pro} replaced by Q_{rust} and R_{rust} for solution without any inhibitor addition).

(ppm - nm)	R_s	Q_{pro}	α_1	R_{pro}	Q_{dl}	α_2	R_{ct}	χ^2
	$(\Omega.cm^2)$	(nF/cm ²)		$(\Omega.cm^2)$	$(\mu F/cm^2)$		$(\Omega.cm^2)$	
0	3517	4.50	0.8993	4373	135	0.1967	3697	0.1989
1000	3535	2.10	0.9933	7146	40	0.8093	40258	0.1812
1010 - 10 nm	3537	2.76	0.9392	8764	58	0.7131	38127	0.4623
1020 - 10 nm	3520	2.58	0.9998	9068	49	0.7892	36879	0.4046
1030 - 10 nm	3530	0.34	0.9999	9670	29	0.8114	43439	0.2572
1030 - 20 nm	3522	2.19	0.8697	3414	69	0.5784	15814	0.3431
1030 - 30 nm	3543	2.55	0.6899	3114	163	0.1965	14929	0.4910
1040 - 10 nm	3516	3.05	0.9943	8671	44	0.6757	25173	0.1288
1050 - 10 nm	3542	3.20	0.9829	8620	55	0.6324	17974	0.3130

Table S3. The simulated ethanol fuel blend contents.

Chemical	Origin	Minimum purity	Proportion (v/v)	
Ethanol	Merck	99.8%	75.6%	
Methanol	Merck	99.8%	4.2%	
Iso-Propanol	Merck	99.5%	4.2%	
RON92	Commercial, unleaded	-	15%	
Deionized water	FI GA Purelah I Iltra	Passed	10/2	
Deformized water		ASTM D1193	1 / 0	
Sodium chloride	Merck	99.5%	15 ppm	
Formic acid	Merck	95.0%	10 ppm	
Acetic acid	Merck	99.7%	20 ppm	



(a)



(b)



Figure S1. SEM images of TNPs with: (a) 10, (b) 20, and (c) 30 nm of diameter.



(a)



(c)

Figure S2. SEM images of exposed specimens in investigated solutions with different of concentration addition: (a) without inhibitor, (b) with 1000 ppm APLE and (c) with 1000 ppm APLE and 30 ppm TNPs.



Figure S3. An equivalent circuit for fitting the impedance data for steel immersed in investigated solutions (CPE_{pro} and R_{pro} are replaced by CPE_{rust} and R_{rust} for steel immersed in solution without any inhibitor addition).



Figure S4. Effect of (a) TNPs' sizes and (b) TNPs' concentrations on corrosion rate of steel in investigated solution.



Ethyl hexadecanoate



(a)







(b)







(c)



(d)

Ethyl hexadecanoate

Figure S5. DFT study of (a) HOMO, (b) LUMO, (c) Nucleophilic f(+) and (d) Electrophilic f(-) of HA and EH isolated optimized molecules.