Supplementary Material

Detection of Adulterated Diesel Using Fluorescent Test Strips and Smartphone Read-out

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I. Photophysical properties of 4-DNS, 4-DNS-OH and 4-DNS-COOH

Table S1. Photophysical properties of **4-DNS**, **4-DNS-OH** and **4-DNS-COOH** in various solvents

Compound	Solvent	λ_{abs} / nm	λ_{em} / nm	φ_F	Stokes Shift / nm
4-DNS	Toluene	430	585	0.530	155
4-DNS	Kerosene	[b]	502	[a]	[b]
4-DNS-OH	Cyclohexane	421	510	0.183	89
4-DNS-OH	*n*-Hexane	416	501	0.118	84
4-DNS-OH	Di-*n*-butylether	432	577	0.096	145
4-DNS-OH	Toluene	436	583	0.532	147
4-DNS-OH	Dioxane	438	661	0.107	222
4-DNS-OH	$CHCl_3$	436	738	0.027	295
4-DNS-OH	CH_2Cl_2	442	760	0.013	318
4-DNS-OH	Dimethylformamide	455	[c]	[c]	[c]
4-DNS-OH	Acetonitrile	442	[c]	[c]	[c]
4-DNS-OH	Ethanol	436	[c]	[c]	[c]
4-DNS-OH	Triethyleneglycol	457	730	0.009	273
4-DNS-OH	H_2O	442	[c]	[c]	[c]
4-DNS-OH	Diesel	429	542	0.434	113
4-DNS-OH	Kerosene	423	512	0.247	89
4-DNS-OH	Gasoline	430	602	0.102	172
4-DNS-OH	THF	444	692	0.076	249
4-DNS-COOH	Kerosene	[b]	508	[a]	[b]

[a] Not calculated. [b] Not measured. [c] Too low / red-shifted to be measured.

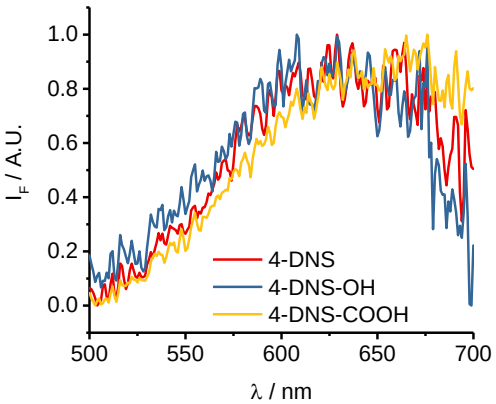

Figure S1. Emission spectra of **4-DNS**, **4-DNS-OH** and **4-DNS-COOH** adsorbed on standard cellulose paper before adding fuels or solvent.

II. Polyaromatic hydrocarbons (PAH) interferences

Stock solutions of PAH-free diesel/kerosene blends with volume ratios of 10:0, 9:1, 8:2, 7:3, 6:4, 5:5, 4:6, 7:3, 8:2, 9:1 and 0:10 were prepared. These solutions were stored at 4 °C in sealed vials to avoid evaporation of hydrocarbons with higher vapor pressure.

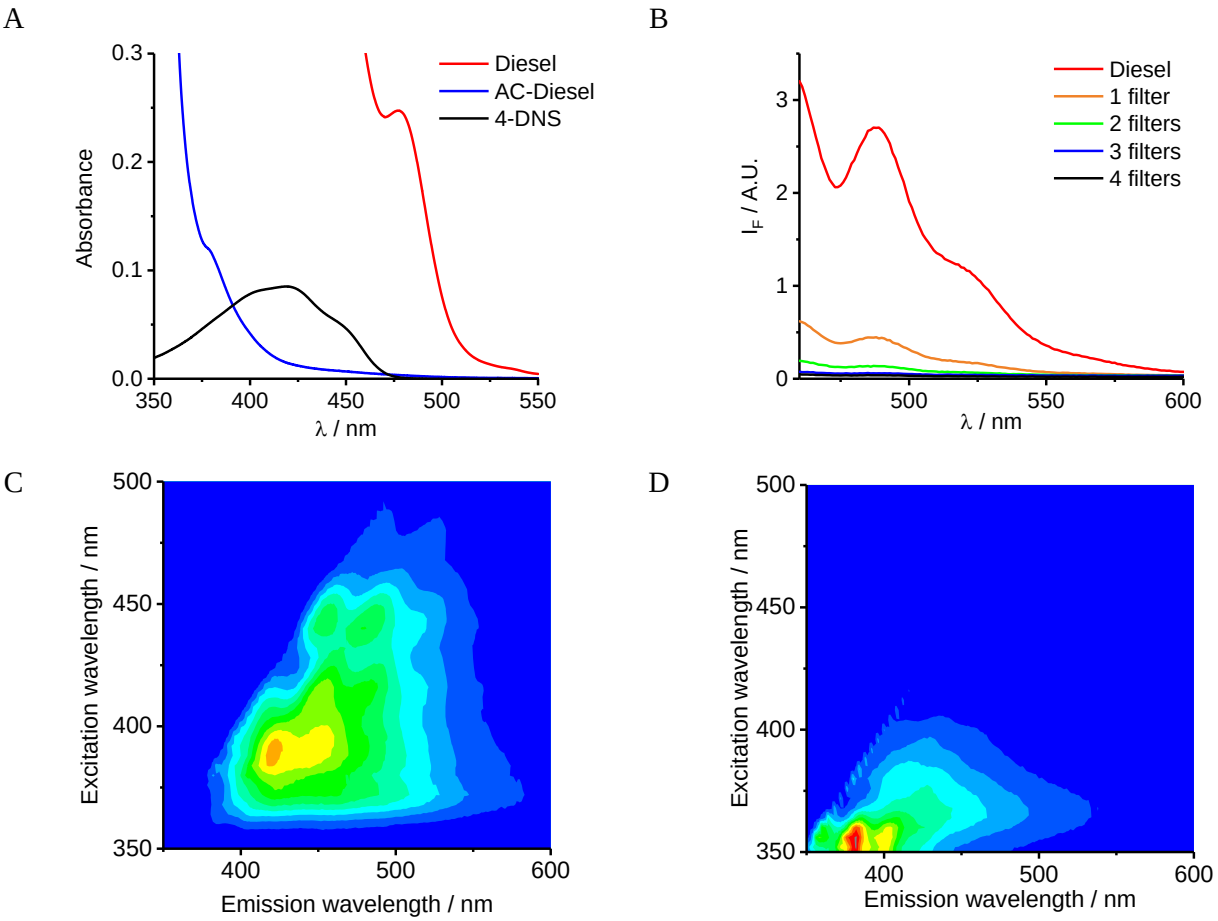

Figure S2. A. Absorption of **4-DNS-OH** (in pentane), fresh diesel and active charcoal treated diesel (AC-Diesel), (Flask method); B. Emission of fresh diesel and diesel after filtration with *n* active charcoal filters; C. and D. Respective excitation−emission matrix for diesel and AC-Diesel with intensity color scale from blue (low) to red (intense).

III. Molecular rotor and viscosities of various diesel/kerosene blends

To ensure correct results, the viscosities of diesel/kerosene blends were measured according to ASTM standard D445 using a commercial calibrated Cannon-Fenske viscometer type 75 with constants of 0.00818 and 0.00815 respectively at 40 °C and 100 °C. The product of the extrapolated constant to our working temperature (0.00802959 for 24 °C) and the efflux time yielded the kinematic viscosities of the blends which agreed with the theoretical viscosities obtained using Arrhenius equation. As expected, an increase of the diesel proportion in the blend, resulted in a non-linear (second order polynomial) increase of the kinematic viscosity.

Diesel	**Elution time**	**Kinematic Viscosity**
vol%	s	$mm^2\ s^{-1}$
100	463	3,72
90	430	3,45
80	403	3,24
70	377	3,03
60	351	2,82
50	334	2,68
40	312	2,51
30	298	2,39
20	275	2,21
10	269	2,16
0	257	2,06

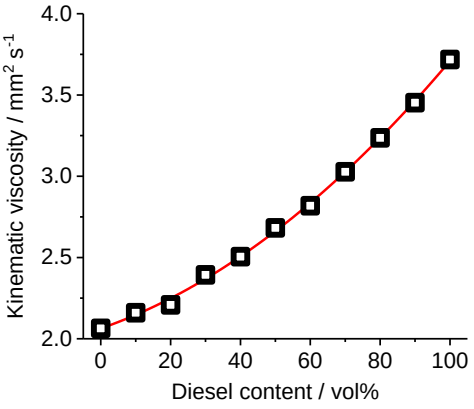

Figure S3. Kinematic viscosities values (left) and plot (right) of the different diesel/kerosene blends.

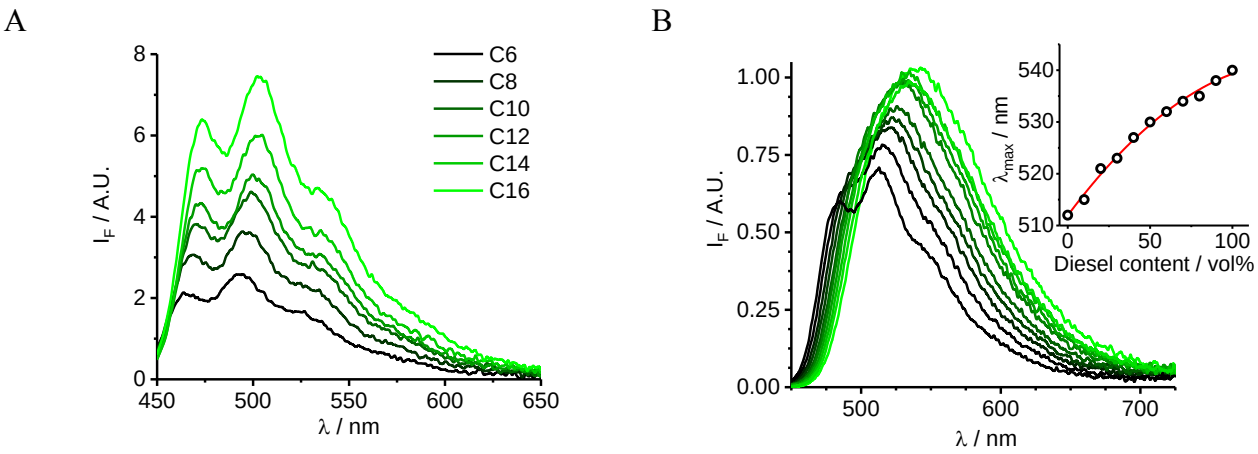

Figure S4. A. Emission of **4-DNS** in pure alkanes from *n*-hexane (C6) to *n*-hexadecane (C16). B. Emission of **4-DNS-OH** in diesel upon increasing content of kerosene in the blend with shift of the emission maxima in the inset (0 – 100 vol%, λ_{exc} = 430 nm).

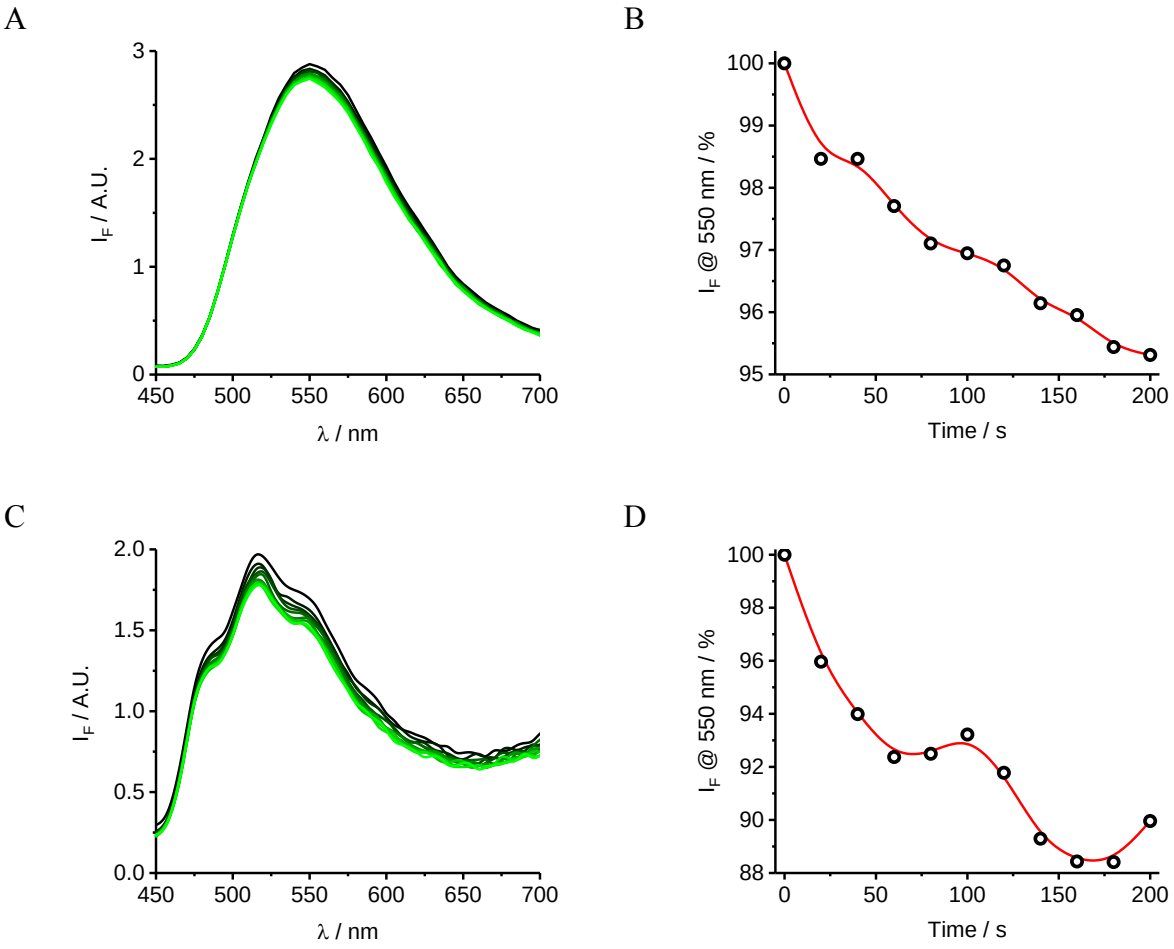

Figure S5. A. and B. Time vs respective fluorescence spectra and emission at 550 nm of **4-DNS-OH** strips after addition of 15 µL of untreated diesel. C. and D. Idem for 15 µL of kerosene (λ_{exc} = 430 nm).

IV. GC-FID validation method

An Agilent 6890 gas chromatograph (GC) equipped with a cool on-column injector coupled to a flame ionization detector was used as validation method for the new rapid test. A 5 m fused silica tubing (ID 0.53 mm, OD 0.67 mm) was used as pre-column and was coupled to a DB-5ms capillary column, 15 m, 0.25 mm, 0.25 µm (J&W 122-5512, Agilent) for separation of the alkanes with helium as carrier gas (1.3 mL min^{-1}). The flame ionization detector was under constant gas flow: H_2: 40 mL min^{-1}, Air: 450 mL min^{-1} and makeup flow (He): 45 mL min^{-1}.

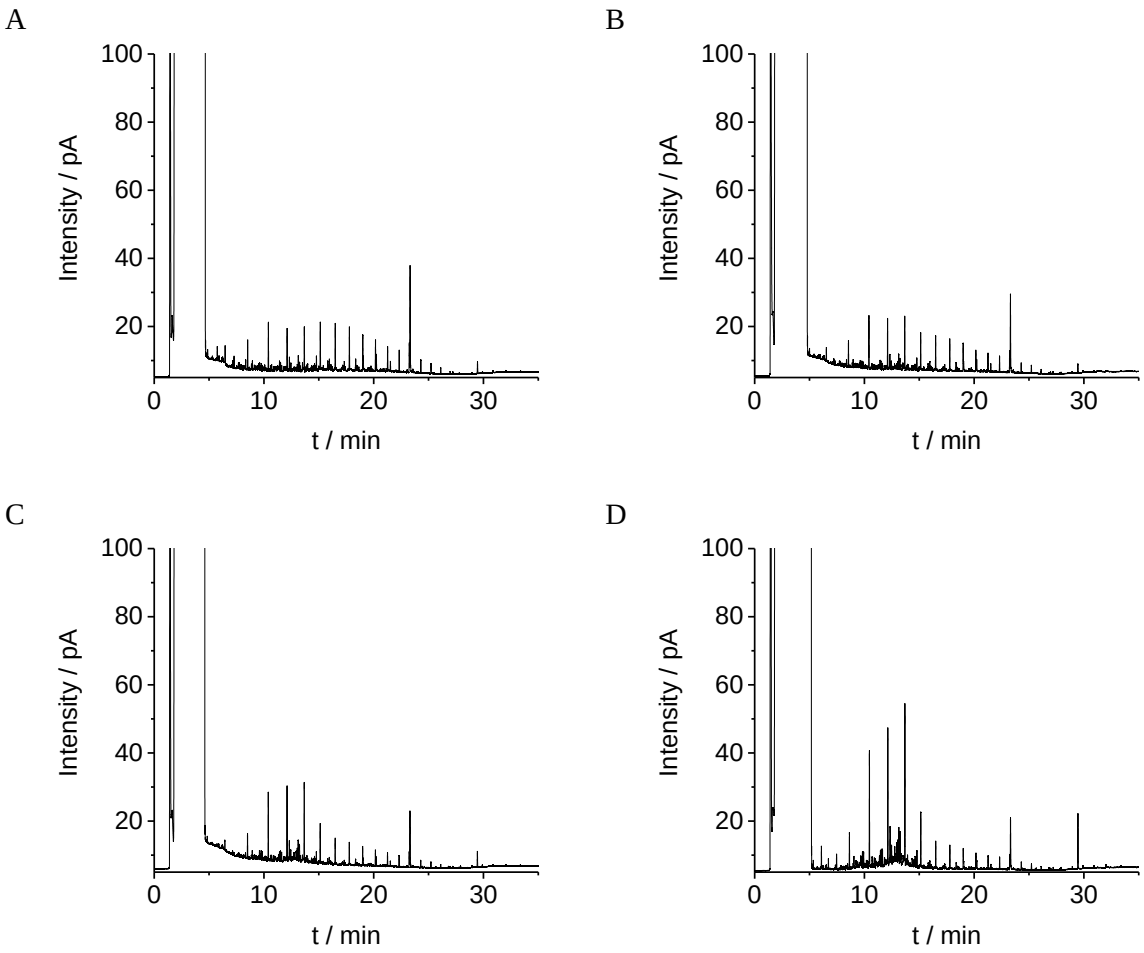

Figure S6. GC-FID chromatograms of various diesel/kerosene blends in vol%: A. 100/0, B. 90/10, C. 70/30, D. 50/50.

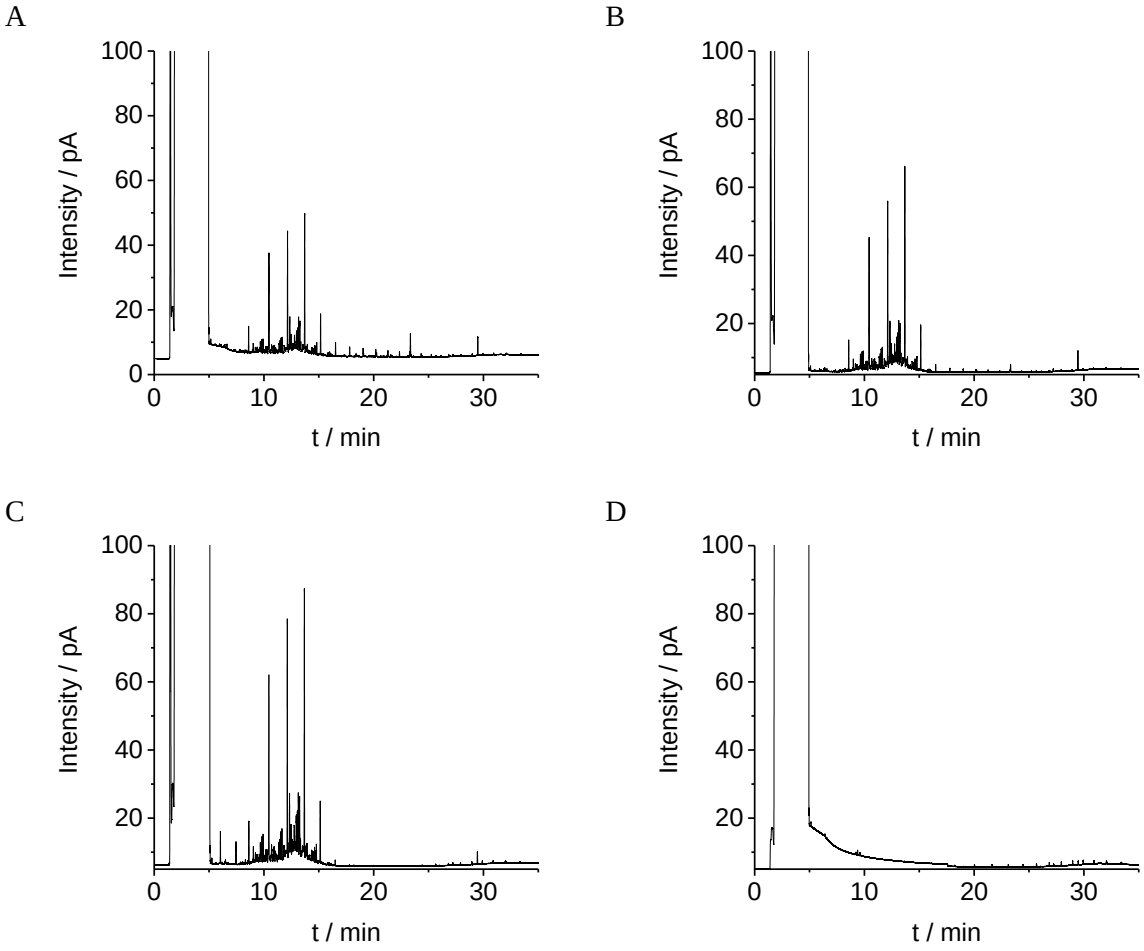

Figure S7. GC-FID chromatograms of various diesel/kerosene blends in vol%: A. 30/70, B. 10/90, C. 0/100 and D. blank.