Electronic Supplementary Material (ESI) for Journal of Materials Chemistry C.

Supporting Information

Charge Transfer Doping in Functionalized Silicon Nanosheets/P3HT Hybrid Material for Applications in Electrolyte-Gated Field-Effect Transistors

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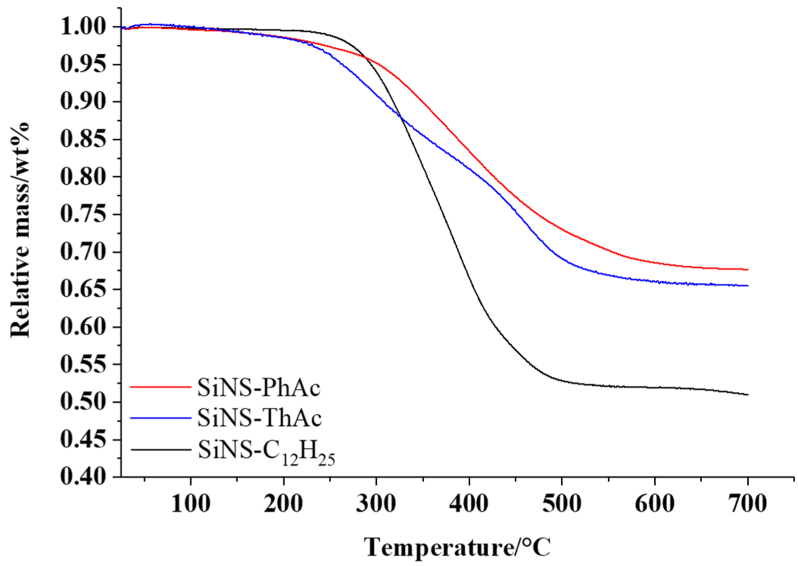

Figure S1. TGA measurements of SiNS-$C_{12}H_{25}$, SiNS-PhAc and SiNS-ThAc.

Table S1. Comparison of the TGA results of SiNS-$C_{12}H_{25}$, SiNS-PhAc and SiNS-ThAc.

Substrate	Molecular weight[a]	wt% loss	wt% loss/molecular weight
1-Dodecene	169.2	47	2.78
Phenylacetylene	103.0	30	2.91
2-Ethinyl-3-hexylthiophene	91.0	33	1.71

[a] Molecular weight is in this case defined as the molecule weight of the organic molecule attached to the surface.

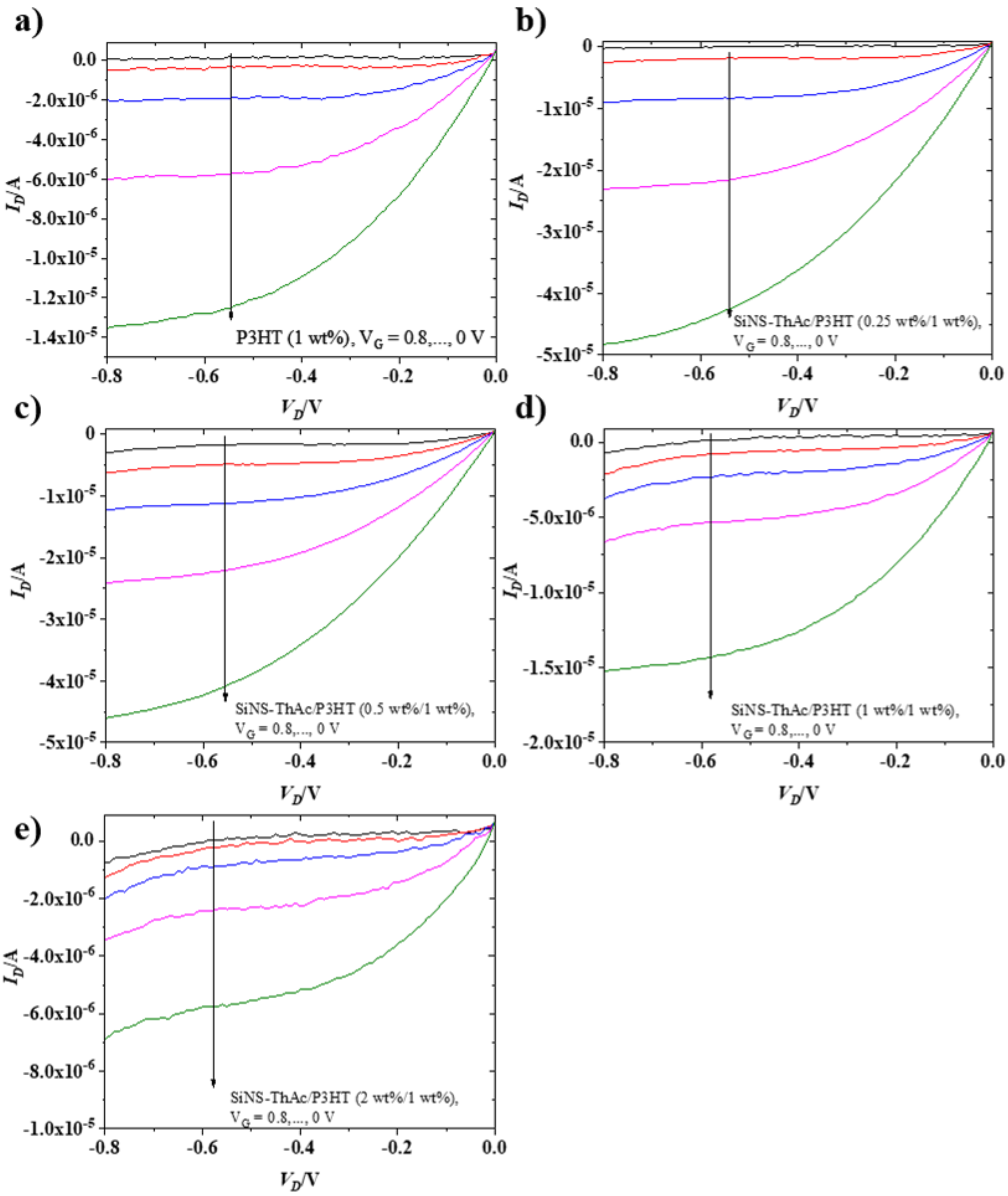

Figure S2. Output characteristics with different gate voltages (0.2 V steps from 0.8 V to 0.0 V) of a) P3HT (1 wt%), b) SiNS-ThAc/P3HT (0.25 wt%/1 wt%), c) SiNS-ThAc/P3HT (0.5 wt%/1 wt%), d) SiNS-ThAc/P3HT (1 wt%/1 wt%), SiNS-ThAc/P3HT (2 wt%/1 wt%).

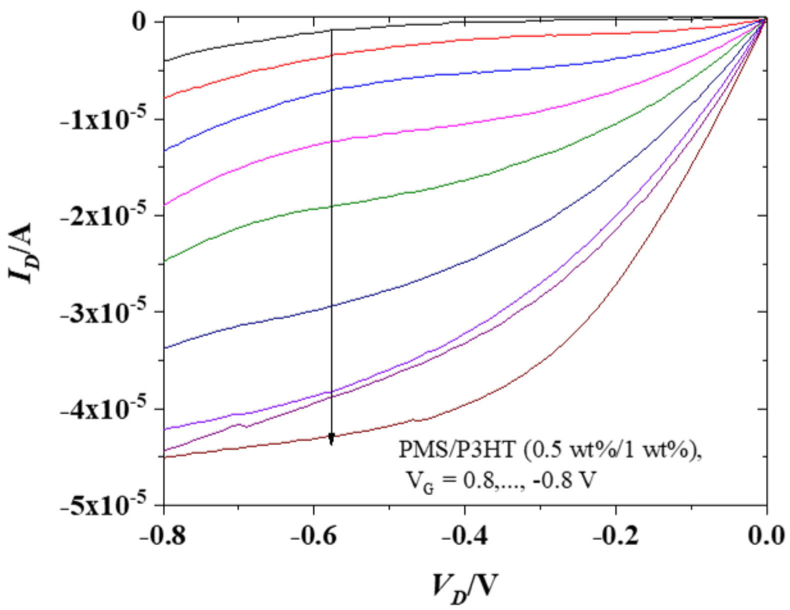

Figure S3. Output curve of PMS/P3HT and its deformed shape in the positive voltage range.

Table S2. I_{ON}/I_{OFF} ratios calculated from the highest (I_{on}) and lowest (I_{off}) currents of the operating device, transconductance (g_m) calculated from the slope of the linear fit in the linear regime of the transfer curves, threshold voltage (V_{Th}) as the x-axis, mobility (**μ_0**),film root mean square roughness (rough.) and film thickness (thick.) for different hybrid films (varied Si-based materials). The formula used for the mobility is: **μ_0** = $g_m/(W/L \cdot V_D \cdot C_G)$; W/L = 900; V_D = -0.1 V; C_G = $7.8 \cdot 10^{-6}$ cm^{2}F.

Substance (wt%/wt%)	**I_{ON}/I_{OFF}**	**g_m (S)**	**V_{Th} (V)**	**μ_0 (cm^2 V^{-1}s^{-1})**	**Film roughness (nm)**	**Film thickness ± 10 nm (nm)**
P3HT	$9.97 \cdot 10^6$	$2.30 \cdot 10^{-5}$	-0.37	$3.3 \cdot 10^{-2}$	2.34	56
PPS/P3HT (0.5/1)	$2.21 \cdot 10^7$	$3.41 \cdot 10^{-5}$	-0.12	$4.9 \cdot 10^{-2}$	3.01	30
PMS/P3HT (0.5/1)	$2.77 \cdot 10^7$	$3.48 \cdot 10^{-5}$	$-9.37 \cdot 10^{-7}$	$5.0 \cdot 10^{-2}$	0.97	32
SiNC-$C_{12}H_{25}$/P3HT (0.5/1)	–	–	–	–	3.96	68
SiNS-ThAc/P3HT (0.5/1)	$3.35 \cdot 10^7$	$4.96 \cdot 10^{-5}$	-0.07	$7.1 \cdot 10^{-2}$	1.85	30

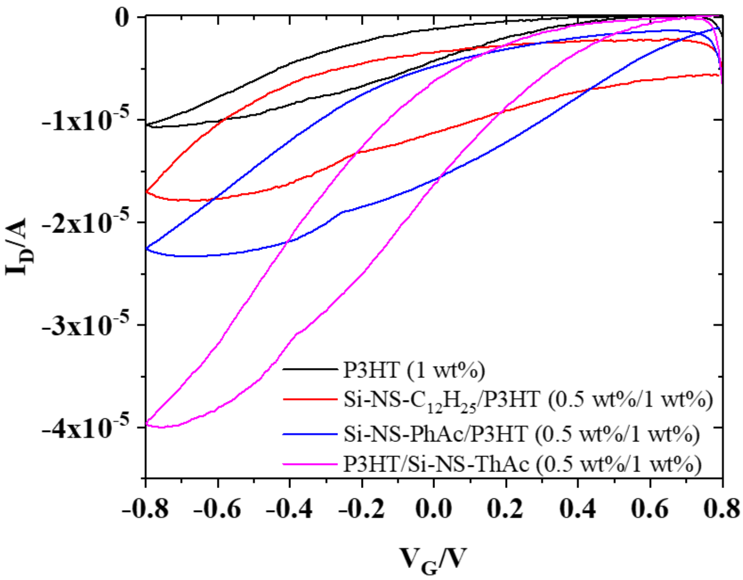

Figure S4. Transfer characteristics with hysteresis (drain voltage, V_D = -0.1 V) of P3HT (1 wt%), SiNS-$C_{12}H_{25}$/P3HT (0.5 wt%/1 wt%), SiNS-PhAc/P3HT (0.5 wt%/1 wt%) and SiNS-ThAc/P3HT (0.5 wt%/1 wt%)-based EGFETs.

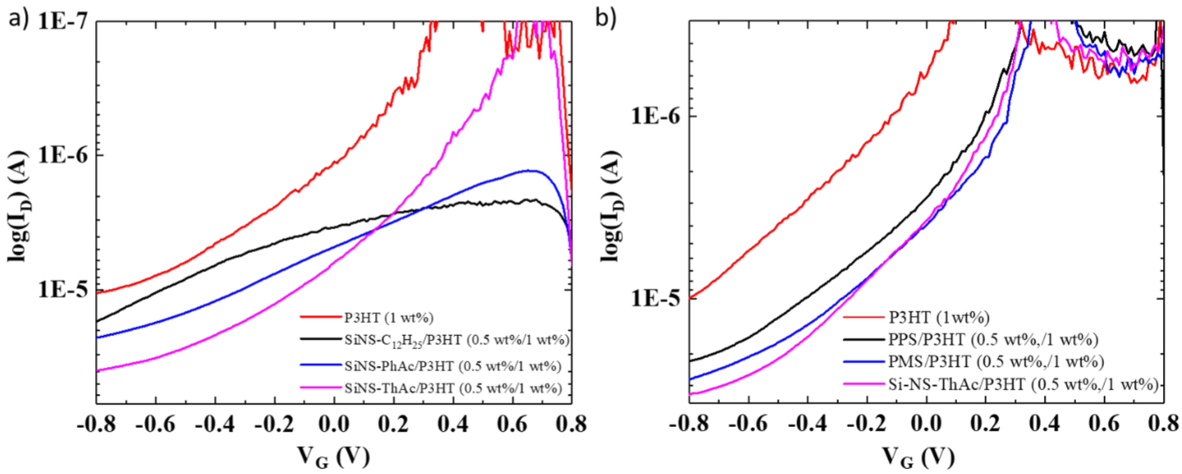

Figure S5. a) b) Transfer characteristics with log-plot (drain voltage, V_D = -0.1 V) of P3HT (1 wt%), SiNS-$C_{12}H_{25}$/P3HT (0.5 wt%/1 wt%), SiNS-PhAc/P3HT (0.5 wt%/1 wt%) and SiNS-ThAc/P3HT (0.5 wt%/1 wt%)-based EGFETs. b) Transfer characteristics with log-plot (drain voltage, V_D = -0.1 V) of P3HT (1 wt%), PPS/P3HT (0.5 wt%/1 wt%), PMS/P3HT (0.5 wt%/1 wt%) and SiNS-ThAc/P3HT (0.5 wt%/1 wt%)-based EGFETs

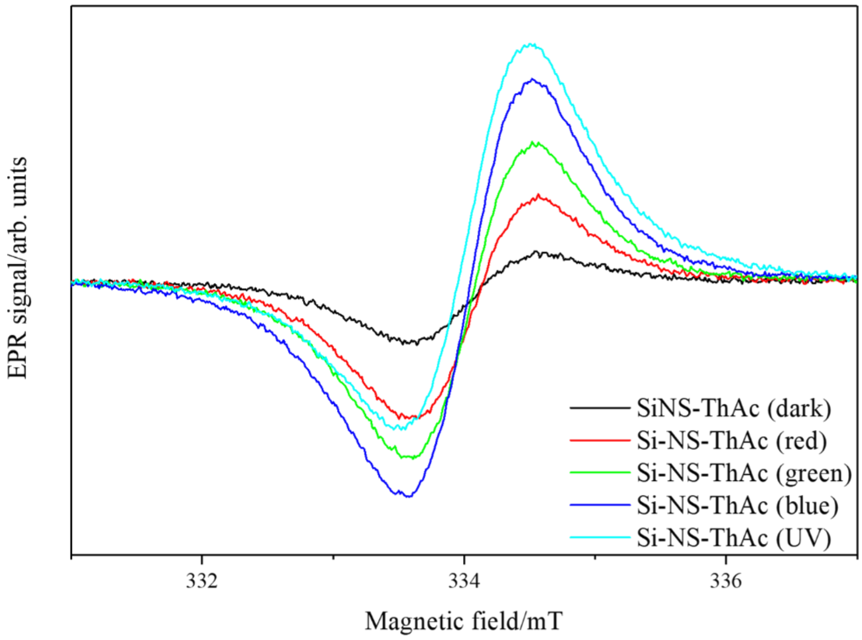

Figure S6: LEPR measurements of SiNS-ThAc at 4 K. The obtained data are calibrated to the same signal range. Red (623 nm), green (525 nm), blue (470 nm) and UV light (390 nm) light sources were used for excitation.

Table S3: Thin-film roughness and thickness of the blends presented in Figure 3.

Substance (wt%/wt%)	**Film root mean square (r.m.s.) roughness (nm)**	**Film thickness ± 10 nm (nm)**
P3HT	2.34	56
SiNS-$C_{12}H_{25}$/P3HT (0.5/1)	1.17	26
SiNS-PhAc/P3HT (0.5/1)	0.84	34
SiNS-ThAc/P3HT (0.5/1)	1.85	30

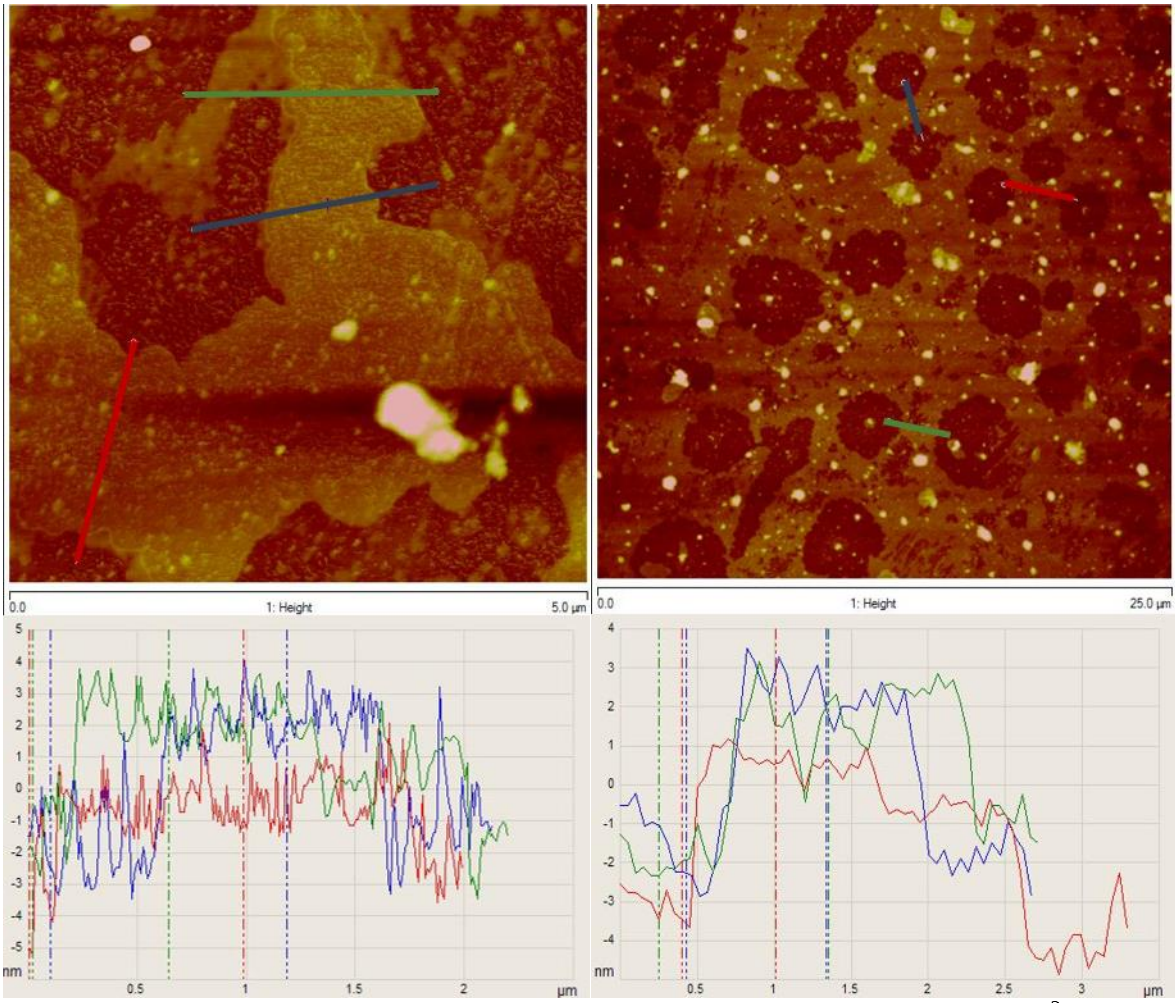

Figure S6: AFM Tapping Mode images of single SiNS-$C_{12}H_{25}$ sheets with 5µm^2 (left) and 25 µm^2 (right) scales. The corresponding height profiles along the lines are shown in the graphs under the AFM images, respectively. Brighter spots represent partially several layers of SiNSs.

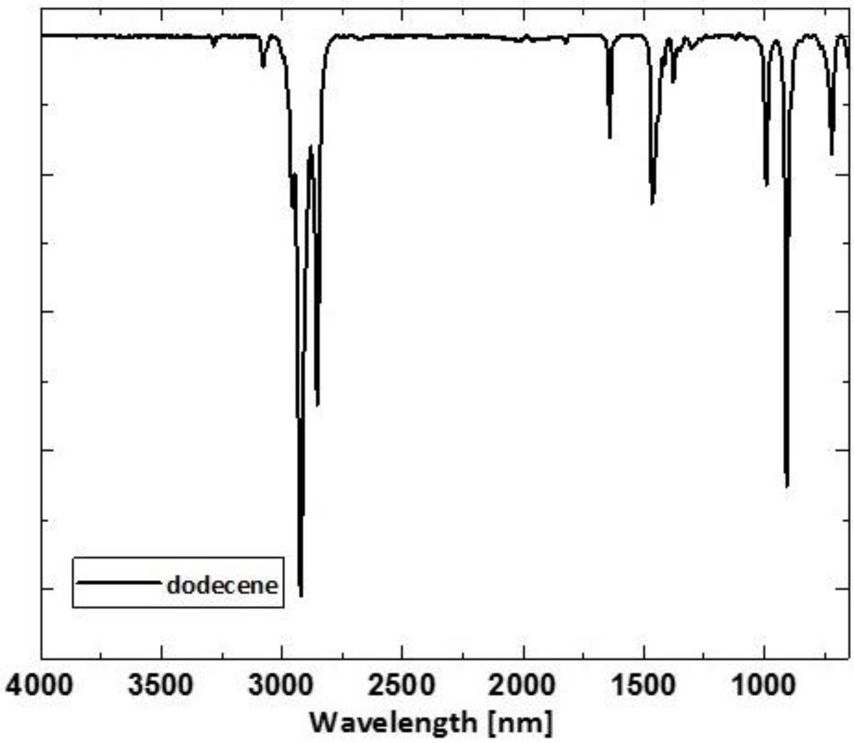

Figure S7: FTIR spectrum of dodecene monomer, which was used for the modification of SiNSs' surface and with it for the synthesis of SiNS-$C_{12}H_{25}$.

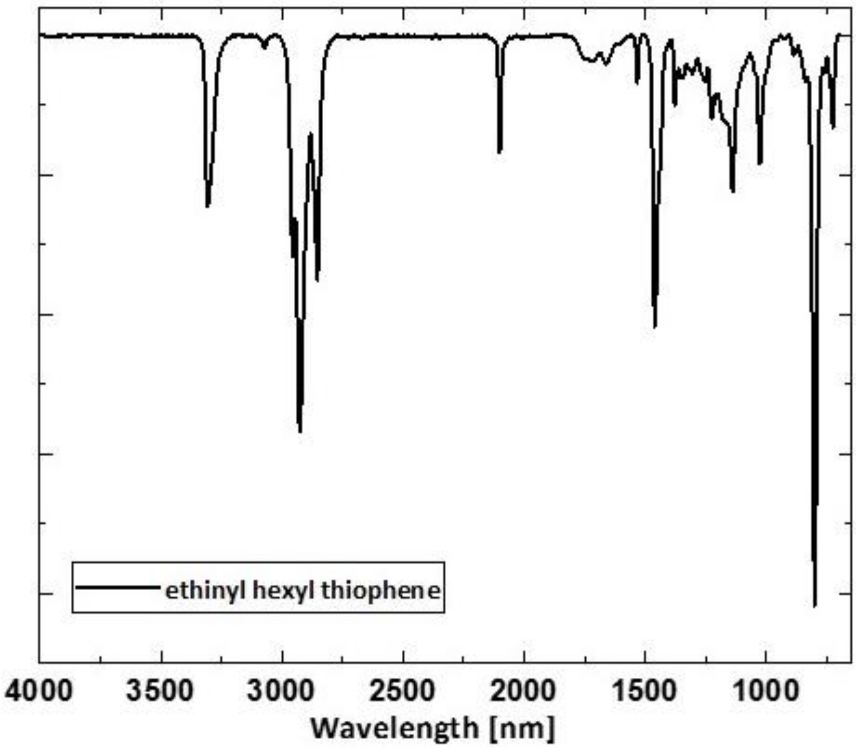

Figure S8: FTIR spectrum of ethyl hexyl thiophene monomer, which was used for the modification of SiNSs' surface.

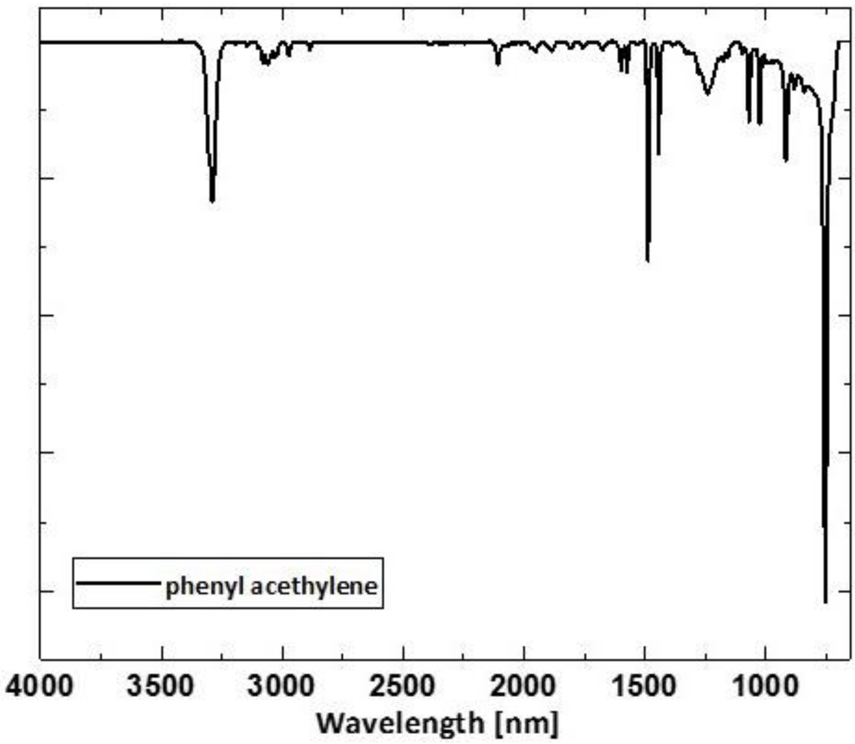

Figure S9: FTIR spectrum of phenyl acethylene monomer, which was used for the modification of SiNSs' surface.