Electronic Supplementary Information

Densely cross-linked polysiloxane dielectric for organic thin-film transistors with enhanced electrical stability

Joo-Young Kim,[a,b‡] Eun Kyung Lee,[a‡] Jiyoung Jung,[a] Don-Wook Lee,[a] Youngjun Yun,[a] Jong Won Chung,[a] Jeong-Il Park,[a] and Jang-Joo Kim*[b]

[a]Material Research Center, Samsung Advanced Institute of Technology (SAIT), Samsung Electronics, Suwon, Gyeonggi-do 16678, Republic of Korea

[b]Department of Materials Science and Engineering, Seoul National University, Seoul 08826, Republic of Korea

Joo-Young Kim and Eun Kyung Lee contributed equally to this work.

Corresponding Author

*Jang-Joo Kim (jjkim@snu.ac.kr)

Table S1 Summarized characteristics of organic-inorganic hybrid dielectrics and performance of the devices fabricated employing them as gate dielectric in literature

Dielectric Material	Process condition	Thickness (nm)	[1)]J-V range ($MV\ cm^{-1}$)	[2)]*k*	Active layer	SAM	Mobility ($cm^2\ V^{-1}\ s^{-1}$)	Hysteresis (V)	[3)]ΔV_{Th} (V)	Ref.
3-methacryloxypropyltrimethoxysilane and zirconium propoxide	170 °C	190 - 265	2	5.5	[a)]DHα4T	-	1.0×10^{-3}	N/A	N/A	23
DPSD (diphenylsilanediol) and MPTMS (3-(Trimethoxysilyl)propyl methacrylate)	150°C, UV	40	3	3.1	Pentacene	-	0.3	Negligible	N/A	24
Anthryl-terminated alkyl-phosphonic acid on UV cured sol-gel HfOx	200°C, UV	4.8	2	-	Pentacene / [b)]TIPS-Pentacene	[g)]PA derivative	0.32 / 0.38	Negligible	N/A	25
PMSQ (poly(methyl silsesquioxane))	150°C	450	3	3.6	[c)]P3HT	-	7.1×10^{-3}	Negligible	on, -1 V (1,000 s)	26
ZrCl4 and α,ω-disilylalkane	150°C, Vacuum	20 - 43	2	5 - 10	Pentacene	-	0.1 - 1.6	Negligible	N/A	27
Solution based ZrO_2 (zirconium-(IV) acetylacetonate as a precursor)	UV	5 - 6	3	~10	[d)]PBTTT-C14	[h)]ODPA	0.2	N/A	N/A	28
Cyclotetrasiloxane and melamine	80°C	400	1	3.79	Pentacene	-	0.36	3.3	N/A	29
ZrTA (zirconium tetraacrylate)	120°C	50 - 60	2	5.48	Pentacene	-	0.5	Negligible	N/A	30
PPMSQ (poly(phenyl-co-methacryl silsesquioxane))	200°C	920 - 980	1	3.1 - 3.6	Pentacene / [e)]PTCDI-C8	-	0.53 / 0.17	N/A	N/A	31
PMMS (poly[(mercaptopropyl)methyl-siloxane])	R.T	1,000	2	5.4	[f)]DPP-DTT / Pentacene	-	5.5×10^{-2} / 1.3×10^{-3}	Negligible	on/off, ~3 V (10,000 s)	32
LPSQ-TMS (trimethylsilyl-capped hybrid ladder-like polysilsesquioxane)	110°C	500	2	-	Pentacene	-	0.6	Negligible	N/A	33
poly(azomethine) containing the isobutyl-substituted T8 cages	100°C	-	N/A	-	P3HT	-	4.3×10^{-3}	Negligible	N/A	34

[1)]Range of electric field applied for evaluating dielectric strength reported (leakage current), [2)]dielectric constant [3)]Shift of threshold voltage under the on/off bias stress condition

[a)]α,ω-Dihexylquaterthiophene, [b)] 6,13-bis(triisopropyl-silylethynyl) pentacene, [c)]poly(3-hexylthiophene-2,5-diyl), [d)]Poly(2,5-bis(3-tetradecylthiophen-2yl(thieno[3,2-b]thiophene), [e)]N,N′-dioctyl-3,4,9,10-perylenedicarboximide, [f)]Diketopyrrolopyrrole-dithiophene-thienothiophene, , [g)]anthryl-terminated alkyl-phosphonic acid, [h)]octadecylphosphonic acid

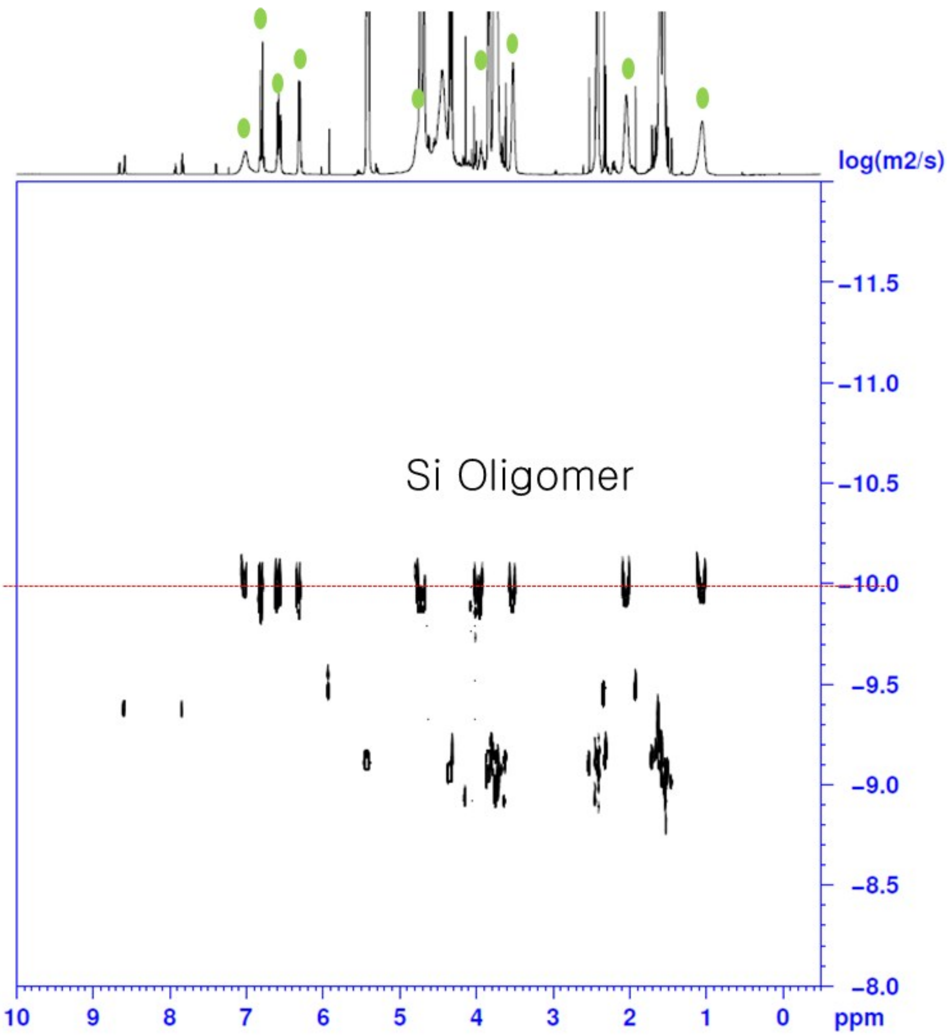

Fig. S1 2D-DOSY NMR of PSUA Solution

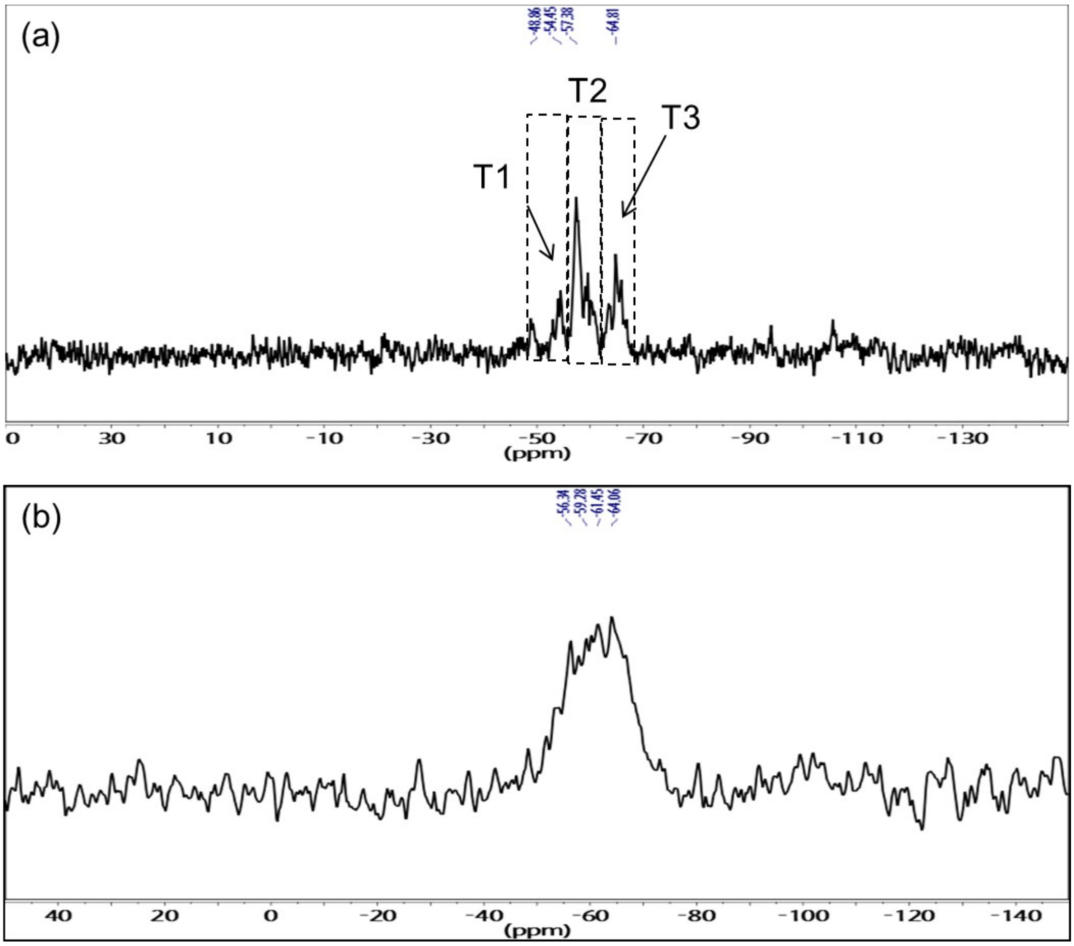

Fig. S2 (a) ^{29}Si NMR of PSUA solution (oligomer)
(b) ^{29}Si CP-MAS NMR of cross-linked PSUAC thin-film (solid)

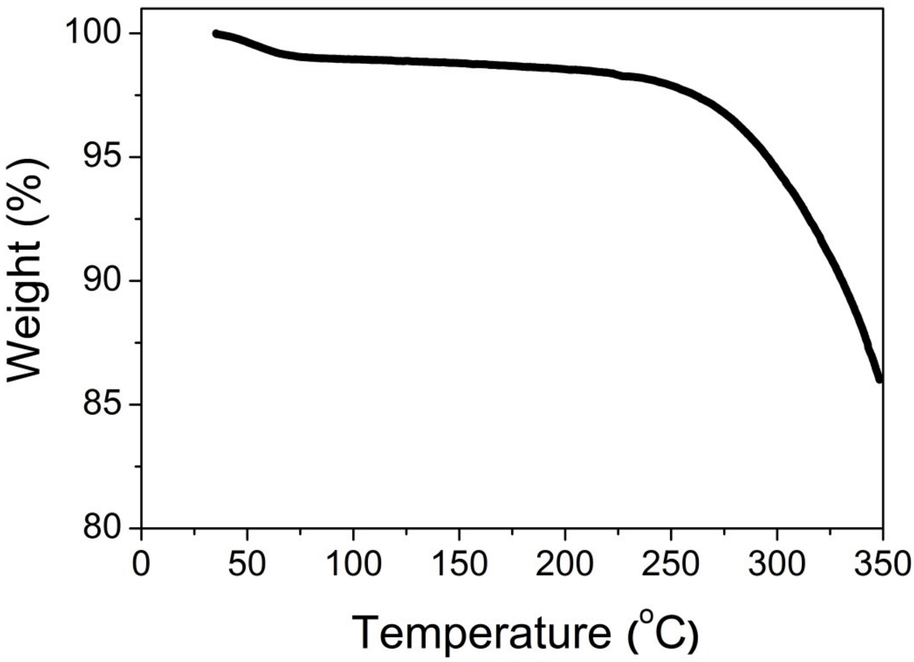

Fig. S3 TGA of cross-linked PSUAC thin-film

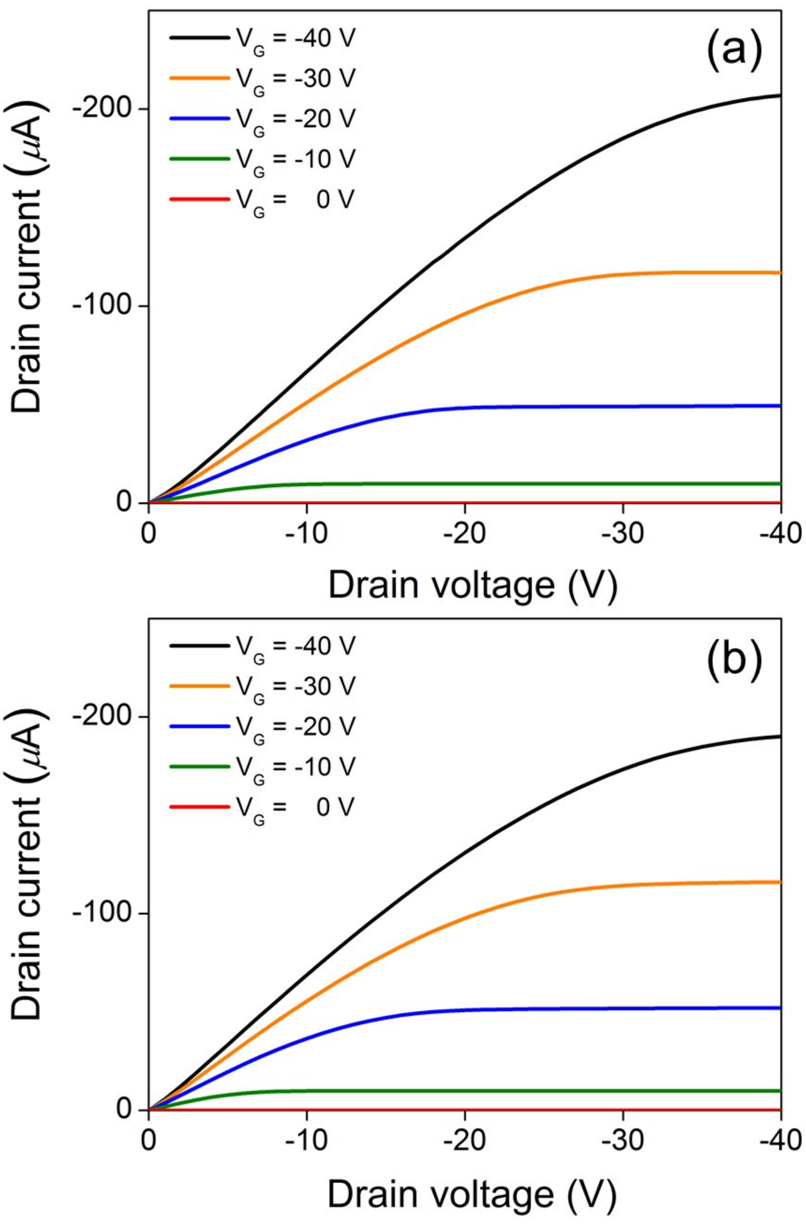

Fig. S4 Output curves of DBTTT TFTs fabricated on (a) PSUAC (b) PECVD SiO_2

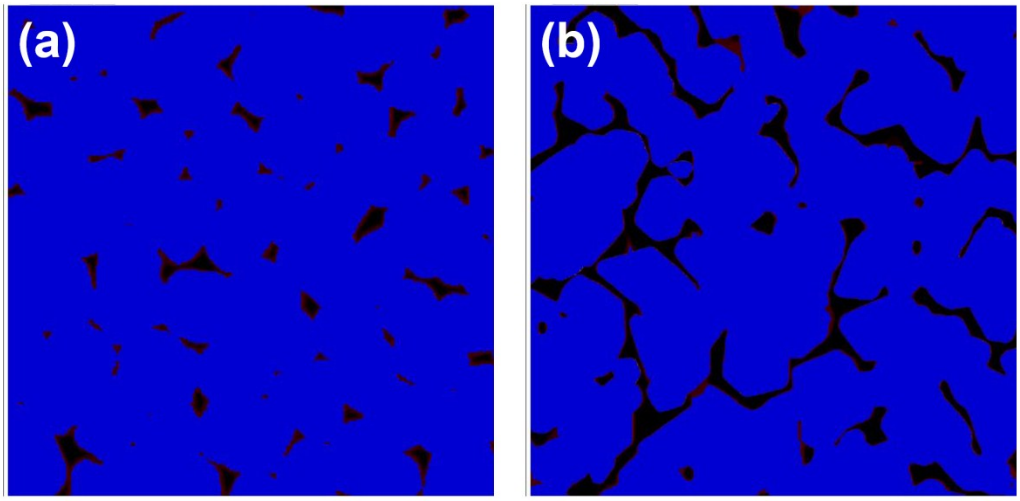

Fig. S5 AFM image analysis of DBTTT morphologies deposited on
(a) PSUAC (b) PECVD SiO_2