

Electrical Transport Properties of [(1-x)Succinonitrile: xPoly(Ethylene Oxide)]- LiCF₃SO₃- Co[tris-(2,2'-bipyridine)]₃(TFSI)₂- Co[tris-(2,2'-bipyridine)]₃(TFSI)₃ Solid Redox Mediators

Ravindra Kumar Gupta,* Hamid Shaikh, Ahamad Imran, Idriss Bedja, Abrar Fahad Ajaj, Abdullah Saleh Aldwayyan, Aslam Khan, and Rashid Ayub

* rgupta@ksu.edu.sa

Supplementary Information

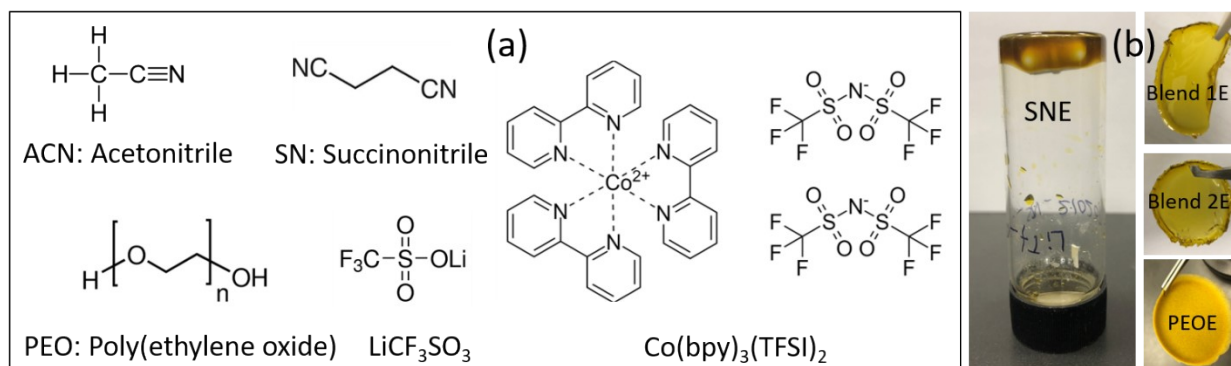


Figure S1. (a) Chemical structure of ingredients and (b) optical image of solid redox mediators.

Table S1. Observed vibrational frequencies (in cm^{-1}) of liquid and solid redox mediators: ACNE, SNE, Blend 1E, Blend 2E, and PEOE. This also included vibrational frequencies of the solvent, matrix, and ionic salts.

ACN [®]	ACNE	SN	SNE	PEO	PEOE	Blend	Blend 1E	Blend 2E	Li salt	Co salt	Assignment [‡]
		481s	481m				479w	479w			δ_{CCC}
	514m		514m		514m		514m	514m	521	514m	$\delta_{\text{a,SO}_3}$
	571m		571m		570m		571m	571m	576	571s	$\delta_{\text{a,SO}_3}$
	602sh	604s	603m		601m	604m	602m	603m	588	601m	$\delta_{\text{CCC}}, \nu_{\text{a,CF}_3}$
	616s		618s		617m		618m	618m		616m	o.p.ring
	653m		653m		651w		652w	652w	641	656m	$\delta_{\text{a,SO}_3}$
753m	738m		738m		737m		738w	738w		740m	$\nu_{\text{a,C-CN}}, \nu_{\text{s,SNS}}$
	766s	762s	769s		777m	762m	777m	778m	766	767s	$\delta_{\text{CH}_2}, \text{ring}, \delta_{\text{s,CF}_3}$
	789m		789m				786sh	786sh		789m	$\nu_{\text{a,SNS}}$
		819s	818m			819w					$\nu_{\text{C-CN}}$
				843s	842m	846m	848m	848m			$\rho_{\text{a,CH}_2}, \nu_{\text{CO}}$
919s	918m	918s	918m			918sh	sh	sh			$\nu_{\text{s,C-CN}}$
		963s	963s	963s	964s	953s	954m	954s			$\rho_{\text{a,CH}_2}, t_{\text{CH}_2}, \nu_{\text{C-CN}}$
		1002s	1002m			1002m	1002w	1002w			ρ_{CH_2}
1039s	1039sh								1032		$\rho_{\text{a,CH}_3}, \nu_{\text{s,SO}_3}$
	1059s		1059s	1061m	1061sh	sh	1061sh	1061sh		1057s	$\nu_{\text{a,COC}}, \rho_{\text{a,CH}_2}, \nu_{\text{a,SNS}}$
				1109s	1115s	1105s	1106s	1106s			$\nu_{\text{s,COC}}$
	1137m		1136s	1149s	1144sh		1135sh	1134sh	1156	1133s	$\nu_{\text{CC}}, \nu_{\text{s,SO}_2}, \nu_{\text{a,CF}_3}$
	1195s	1199m	1196s		1195s	1196w	1196s	1196s	1165	1196s	$t_{\text{CH}_2}, \nu_{\text{a,CF}_3}$
	1228sh	1233s	1227sh			sh	1227w	1227w	1226	1229sh	$t_{\text{CH}_2}, \text{i.p.ring}, \nu_{\text{s,CF}_3}$
				1242m	1242m	1251m	1250w	1250w	1258		$t_{\text{a,CH}_2}, \nu_{\text{a,SO}_3}$
				1280m	1280m	1299m	1309w	1300w	1272		$t_{\text{a,CH}_2}, t_{\text{s,CH}_2}, \nu_{\text{a,SO}_3}$
		1337s	1337sh			sh	1334sh	1334sh		1331sh	$\omega_{\text{CH}_2}, \nu_{\text{a,SO}_2}$
	1353s		1352s	1342s	1343s	1350m	1353s	1353s		1351s	$\omega_{\text{a,CH}_2}, \nu_{\text{a,SO}_2}$
1374s	1375m										$\omega_{\text{s,CH}_2}$
		1426s	1426s			1426s	1427w	1427m			δ_{CH_2}
1443s	1444m		1443sh	1454m	1454w	1453w	1437w	sh		1453m	$\delta_{\text{a,CH}_2}, \text{ring}$
	1474m		1474m	1467m	1467m	1469w	1473w	1472w		1470m	$\delta_{\text{a,CH}_2}, \text{ring}$
2252s	2254s	2254s	2254s			2251s	2253m	2253s			$\nu_{\text{s,C=N}}$
2293s	2293w			2861sh		2875s	2878s	2877s			$\nu_{\text{s,CH}_2}$
				2889s	2890s	2899s	2907s	2905s			$\nu_{\text{a,CH}_2}$
2942m	2944w	2952s	2952s			2943sh	2945sh	2946sh			$\nu_{\text{s,CH}_2}$
3001m	3004w	2989s	2989s			2975sh	2980sh	2980sh			$\nu_{\text{a,CH}_2}$

©Notation for relative intensity: w (weak), m (medium), s (strong), and sh (shoulder). ‡Notation for modes: stretching (ν), bending (δ), wagging (ω), twisting (t), and rocking (ρ) modes. s, symmetric mode. a, asymmetric mode. i.p., in-plane. o.p., out-of-plane.

Table S2. Chemicals/ paste used for synthesis/ DSSC fabrication.

Chemicals/ Paste	Purity (%)	Make
Acetonitrile (ACN)	99.9	Fisher Scientific, USA
Tetrahydrofuran	99.8	VWR, USA
Absolute Ethanol	99.5	Fisher Scientific, USA
Poly(ethylene oxide)	99	Sigma-Aldrich, Inc., USA
Succinonitrile	99	Sigma-Aldrich, Inc., USA
LiCF ₃ SO ₃	96	Sigma-Aldrich, Inc., USA
Titanium(IV) chloride	99.9	Sigma-Aldrich, Inc., USA
Chenodeoxycholic acid	96	Sigma-Aldrich, Inc., USA
Co(bpy) ₃ (TFSI) ₂	-	Dyename, Sweden
Co(bpy) ₃ (TFSI) ₃	-	Dyename, Sweden
Y123 dye	-	Dyename, Sweden
18NRT paste (TiO ₂ particle size 18 nm)	-	Dyesol, Australia
Ti-Nanoxide R/SP paste (TiO ₂ particle size > 100 nm)	-	Solaronix, Switzerland
Meltonix 1170-25 μm film	-	Solaronix, Switzerland

Table S3. Composition of liquid and solid redox mediators: ACNE, SNE, Blend 1E, Blend 2E, and PEOE.

Electrolyte	x (weight fraction)	EO/Li ⁺	Poly(ethylene oxide) (g)	Acetonitrile/ Succinonitrile (g)	LiCF ₃ SO ₃ (g)	Co(bpy) ₃ (TFSI) ₂ (g)	Co(bpy) ₃ (TFSI) ₃ (g)
ACNE	-	-	-	0.4347	0.0090	0.1504	0.0454
SNE	0	-	-	0.5500	0.0090	0.1504	0.0454
Blend 1E	0.5	108.4	0.2750	0.2750	0.0090	0.1504	0.0454
Blend 2E	0.5	216.8	0.5500	0.5500	0.0090	0.1504	0.0454
PEOE	1	216.8	0.5500	-	0.0090	0.1504	0.0454