

Small Literature Survey of Recipes for DSSCs and ss-DSSCs

DSSCs with liquid electrolytes		Basic Dye Properties						Solar Cell Characterization										Electron transport																		
dye	reference	$\epsilon / M^{-1}cm^{-1}$	$\lambda / nm$	solvent	$E_{ox}/ eV$	$E_{red}/ eV$	area / cm <sup>2</sup>	intensity	$I_{sc} / (mA/cm^2)$	$V_{oc} / mV$	FF	$\eta / \%$	IPCE / %	$\lambda / nm$	remaind $\eta / \%$	at °C	after h	comment	anode	TiO <sub>2</sub>	$d / \mu m$	Cleaning procedure	e' cond.	layer / $\mu m$	dense/nr	applicat.	particle size/nm	appl.	slintering	temp. °C	time/h	conc. mM	temp. °C	time/h	comment	
Z907-HDMA	31 Wang2003							100 mW/cm <sup>2</sup>	15.2	764	0.676	<b>7.8</b>			>90	55	1000		FTO		10 (4)		TiO <sub>2</sub>					20 (400)	SP	500	0.25	50 (40)	70	0.5		
Z907	31 Wang2003							100 mW/cm <sup>2</sup>	14.2	713	0.708	<b>7.2</b>							FTO		10 (4)		TiO <sub>2</sub>				20 (400)	SP	500	0.25	50 (40)	70	0.5			
Z907	19 Kuang2008							100 mW/cm <sup>2</sup>	13.9	731	0.69	<b>7.0</b>											TiO <sub>2</sub>				20 (400)	SP	500	0.25	50 (40)	70	0.5			
K51	19 Kuang2008							100 mW/cm <sup>2</sup>	14.8	730	0.715	<b>7.7</b>											TiO <sub>2</sub>				20 (400)	SP	500	0.25	50 (40)	70	0.5			
R58	19 Kuang2008							100 mW/cm <sup>2</sup>	14.4	762	0.699	<b>7.6</b>											TiO <sub>2</sub>				20 (400)	SP	500	0.25	50 (40)	70	0.5			
K19	22 Nazeenuddin2007							100 mW/cm <sup>2</sup>	15.1	747	0.699	<b>8.0</b>											det (15), H <sub>2</sub> O, EL, UV, O <sub>2</sub> (16)	TiO <sub>2</sub>	maybe 12(3)		20 (400)	SP	500	0.5	40 (40)	70	0.5			
N719	11 Ito2005	1.74E+04	535 Et.					100 mW/cm <sup>2</sup>	16.6	778	0.731	<b>9.4</b>											TiO <sub>2</sub>	14(4)	-	20 (400)	SP	500	0.5	40 (40)	70	0.5				
N719	11 Ito2005	1.36E+04	535					100 mW/cm <sup>2</sup>	17.6	805	0.738	<b>10.5</b>											TiO <sub>2</sub>	14(4)	yes	20 (400)	SP	500	0.5	40 (40)	70	0.5				
N719	11 Ito2005							100 mW/cm <sup>2</sup>	18.7	798	0.713	<b>10.6</b>											TiO <sub>2</sub>	14(4)	yes	20 (400)	SP	500	0.5	40 (40)	70	0.5				
N719	22 Nazeenuddin2007							100 mW/cm <sup>2</sup>	15.82	785	0.75	<b>9.31</b>											TiO <sub>2</sub>	13		20 (400)	SP	500	0.5	40 (40)	70	0.5				
N719	2 Boschloo2006						0.785																TiO <sub>2</sub>	13		20 (400)	SP	450	0.5							
N719	2 Boschloo2006						0.785																TiO <sub>2</sub>	13		20 (400)	SP	450	0.5							
N719	24 Sarin2008						(100 mW/cm <sup>2</sup> )	18.11	621	0.585	<b>6.58</b>												TiO <sub>2</sub>	16.1 (16.7)		20 (30)	SP	450	0.5							
N719	15 Karthikayan2007				-5.9	-3.4																	ZnO													
N719	20 Martinson2007						0.28	906 W/m <sup>2</sup>	3.3	739	0.64	<b>1.6</b>											Al <sub>2</sub> O <sub>3</sub> template			ALD	400	0.5								ALD-ZnO on Al <sub>2</sub> O <sub>3</sub>
N719	14 Kakuchi2006							100 mW/cm <sup>2</sup>	12.6	668	0.481	<b>4.1</b>				60	460-550						ZnO	20		ca. 12		450	0.6							
D102	9 Horieuch2003	5.58E+04	491	AN:7-butanol	-5.56			100 mW/cm <sup>2</sup>	11.68	775	0.72	<b>6.5</b>											TiO <sub>2</sub>	4.5		20 (400)	SP	550	0.5							
NKX-2311	9 Horieuch2003				-5.54			100 mW/cm <sup>2</sup>	19	0.66	0.70	<b>8.9</b>											TiO <sub>2</sub>	12 (4)		20 (400)	SP	430/520	0.5	40						
D21L6	112 Yum2009	3.70E+04	458 Et.		0.98V vs. NHE	-1.35V vs. NHE		100 mW/cm <sup>2</sup>	14.1	728	0.71	<b>7.25</b>				90	60	1000	stab. test in IL					TiO <sub>2</sub>	13		20 (400)	SP	500	0.5						
D5	8 Hagberg2008							100 mW/cm <sup>2</sup>	12	688	0.72	<b>5.84</b>	-85	-450-560										TiO <sub>2</sub>	7 (5)	-	20 (400)	SP	500	0.5	yes (yes)					
D7	8 Hagberg2008							100 mW/cm <sup>2</sup>	11	695	0.71	<b>5.43</b>	-85	-450-550										TiO <sub>2</sub>	7 (5)	-	20 (400)	SP	500	0.5	yes (yes)					
D9	8 Hagberg2008							100 mW/cm <sup>2</sup>	14	694	0.71	<b>6.9</b>	-85	-450-590										TiO <sub>2</sub>	7 (5)	-	20 (400)	SP	500	0.5	yes (yes)					
D11	8 Hagberg2008							100 mW/cm <sup>2</sup>	13.5	744	0.7	<b>7.03</b>	-85	-450-590		90	60	1000						TiO <sub>2</sub>	7 (5)	-	20 (400)	SP	500	0.5	yes (yes)					
D11	8 Hagberg2008							100 mW/cm <sup>2</sup>	12.3	765	0.7	<b>6.59</b>	-79	-450-590										TiO <sub>2</sub>	<b>2.5 (8)</b>	-	20 (400)	SP	500	0.5	yes (yes)					
D149	12 Ito2006	6.87E+04	526					100 mW/cm <sup>2</sup>	19.96	653	0.694	<b>9.03</b>											TiO <sub>2</sub>	12.6(4-5)	-	20 (400)	SP	500	0.5	40 (40)	70	0.5				
C201	32 Wang2008							100 mW/cm <sup>2</sup>	13.35	777	0.749	<b>7.8</b>												TiO <sub>2</sub>	7(4)	-	20 (400)	SP	500	0.5						
(Zn-Pw)	14 Campbell2007							100 mW/cm <sup>2</sup>	13.44	686	0.65	<b>5.88</b>												TiO <sub>2</sub>	10 (4)	-	20 (400)	SP	500	0.5						
D21L6	33 Yum2009							1 sun	13.44	686	0.65	<b>5.88</b>												TiO <sub>2</sub>												
C201	32 Wang2008							100 mW/cm <sup>2</sup>	12.4	723	0.779	<b>7</b>												TiO <sub>2</sub>	7(4)	-	20 (400)	SP	500	0.5						
<b>ss-DSSCs with the solid hole transport material spiro-MeOTAD:</b>																																				
N3	1 Bach1998			Et.				8.4 mW/cm <sup>2</sup>	0.32	342	0.62	<b>0.74</b>	33			80-120 %		80 h						TiO <sub>2</sub>	4.2	yes	SPD	SP								
N719	17 Krüger2001							1.07 mW/cm <sup>2</sup>	5	910	0.41	<b>2.56</b>	-37	520	95%	RT	3 month							TiO <sub>2</sub>	2.5	yes	SPD	SPD								
N719	18 Krüger2002							0.16	3.5	821	0.69	<b>2.1</b>												TiO <sub>2</sub>	2	yes	SPD	SPD								
N719	18 Krüger2002							0.16	4.6	931	0.71	<b>3.2</b>												TiO <sub>2</sub>	6	sev. tens	12	DB	450	0.5						
N719	6 Fabregat-Santiago2006							0.2				<b>1.0</b>												TiO <sub>2</sub>	2	yes	SPD	DB	450							
Zn-1	25 Schmidt-Mende2005				-5.62	-3.46		100 mW/cm <sup>2</sup>	5.0	731	0.663	<b>2.44</b>	20 / 60	560-630/440										TiO <sub>2</sub>	-2	<100	SPD	18	DB	450						
Zn-2	25 Schmidt-Mende2005				-5.52	-3.56		100 mW/cm <sup>2</sup>	5.9	790	0.651	<b>3.0</b>	25 / 65	570-650/440										TiO <sub>2</sub>	-2	<100	SPD	18	DB	450						
D102	27 Schmidt-Mende2005b	5.58E+04					0.152	100 mW/cm <sup>2</sup>	7.7	866	0.612	<b>4.1</b>	-60	440-550										TiO <sub>2</sub>	1.6	100	SPD	18	DB	450						
Z907	26 Schmidt-Mende2005a							100 mW/cm <sup>2</sup>	8.3	752	0.64	<b>4.0</b>												TiO <sub>2</sub>	2	yes	SPD	DB	450							
Z907	26 Schmidt-Mende2005a							100 mW/cm <sup>2</sup>	5.5	858	0.67	<b>3.1</b>												TiO <sub>2</sub>	2	yes	SPD	DB	450							
Z907	28 Schmidt-Mende2006							100 mW/cm <sup>2</sup>	8.32	752	0.643	<b>4.03</b>												TiO <sub>2</sub>	2	100	SPD	18	DB	450	0.25	20	RT	o.n.		
Z907	7 Fabregat-Santiago2009						0.128		8.1	860	0.51	<b>4</b>												TiO <sub>2</sub>	1.8	100	SPD	20	DB	450						
Z907	5 Ding2009							100 mW/cm <sup>2</sup>	10.3	765	0.67	<b>3.5</b>												TiO <sub>2</sub>	100	SPD-O <sub>2</sub>	SP	500 (450)	0.5	20 (20)	60	6				
K51	29 Snath2006a						0.16																	TiO <sub>2</sub>	100	SPD-O <sub>2</sub>	DB	500	0.5	20	RT	6				
K58	30 Snath2008							100 mW/cm <sup>2</sup>	6.31	865	0.57	<b>3.11</b>				90	60																			

Dye		Staining				Hole transport																				
dye-conc. / mM	solvent	time/h	temp./°C	comment	solvent 1	Vol.-%	solvent 2	Vol.-%	iodine (I <sub>2</sub> )	Spiro-MeOTAD	Li / M	TFSH-Li	TFSH-Li	tBP / M	tBP	Add. 1	conc. / M	Add. 2	conc. / M	sealant	cathode	appl.	th. / nm	comment		
0.3 ± 0.075	AN-i-butanol 1:1	12	RT		MPN	100			0.1							pmii	0.6	NMBI	0.45	Bynel hot melt ring, 35 µm thick	Pt-FTO			heating posttreatment at 55°C for 4 h, electrolyte filled in with vacuum, hole drilled by sand blasting		
0.3	AN-i-butanol 1:1	12	RT		MPN	100			0.1							pmii	0.6	NMBI	0.45	Bynel hot melt ring, 35 µm thick	Pt-FTO			heating posttreatment at 55°C for 4 h, electrolyte filled in with vacuum, hole drilled by sand blasting		
0.3	AN-i-butanol 1:1	20-24	RT		MPN	100			0.1							dmpli	0.8	NMBI	0.5	35 µm thick Bynel ring	Pt-FTO			0.005 M hexachloroplatinic acid in isopropanol at 400 °C for 15 min		
					AN	85	VN	15	0.03							mbli	0.6	GuNCS	0.1	35 µm thick Bynel ring	Pt-FTO			0.005 M hexachloroplatinic acid in isopropanol at 400 °C for 15 min		
					AN	85	VN	15	0.03							mbli	0.6	GuNCS	0.1	25 µm Surlyn 1702	Pt-FTO			0.005 M hexachloroplatinic acid in isopropanol at 400 °C for 15 min		
0.5	AN-i-butanol 1:1	24	RT		AN	85	VN	15	0.03							mbli	0.6	GuNCS	0.1	Surlyn 1702	Pt-FTO			H2PtCl6 in ethanol (hole drilled by sand blaster, then cleaned with water in USB, acetone and 0.1 M HCl-aq, after Pt application: 400°C 15 min)		
0.3	AN-i-butanol 1:1	20-24	RT		MPN	100			0.1							dmpli	0.8	NMBI	0.5	25 µm Surlyn 1702	Pt-FTO			H2PtCl6 in ethanol (hole drilled by sand blaster, then cleaned with water in USB, acetone and 0.1 M HCl-aq, after Pt application: 400°C 15 min)		
0.5	ethanol	12	RT		MPN	100			0.05		0.7			0.055												
0.5	ethanol	12	RT		MPN	100			0.05		0.7			0.5												
0.3	ethanol	1.5	60		MPN	100			0.05		0.1			1		dmpli	0.6									
0.5	ethanol	0.5		desorption in 10 mM KOH	MPN	100			0.05		0.5			0.5												
0.3	ethanol	3	80	1h excess-dye desorption																						
0.3	AN-i-butanol 1:1	18	RT		AN	100			0.05		0.1			0.5		dmpli	0.6									
0.3	AN-i-butanol 1:1	20	RT		AN	50	VN	50	0.05		0.1			0.5		dmpli	0.6									
0.3	AN-i-butanol 1:1	0. n.		rinsed with AN	MPN	100			0.1		0.1			0.5		TBAI	0.6			Surlyn 1472	Pt-FTO			sputtered		
					AN	100			0.05		(0.1)			0.5		pmii	0.6	(GuNCS)	(0.1)						Examination the effect of TiCl <sub>4</sub> treatment	
0.5	AN-i-butanol 1:1	17			MPN	100			0.05		0.1			0.6		dmli	0.5									
0.5	AN-i-butanol 1:1	17			MPN	100			0.05		0.1					dmli	0.5									
0.3	ethanol	15	RT		AN	85	VN	15	0.04	0.025			0.28		mbli	0.6	GuNCS	0.05								
0.3	ethanol+10 mM Cl	4	RT		AN	85	VN	15	0.04	0.025			0.28		mbli	0.6	GuNCS	0.05	Surlyn 1702, 25µm	Pt-FTO					Sealant Bynel used to close the hole, antireflection and UV-cut off-film was attached: ARKTOP from Asahi Glass	
0.3	ethanol+10 mM Cl	4	RT		AN	85	VN	15	0.04	0.025			0.28		mbli	0.6	GuNCS	0.05	Surlyn 1702, 25µm	Pt-FTO						
0.3	ethanol+10 mM Cl	4	RT		AN	85	VN	15	0.04	0.025			0.28		mbli	0.6	GuNCS	0.05	Surlyn 1702, 25µm	Pt-FTO						
0.3	ethanol+10 mM Cl	4	RT		AN	85	VN	15	0.04	0.025			0.28		mbli	0.6	GuNCS	0.05	Surlyn 1702, 25µm	Pt-FTO						
0.5	AN-i-butanol 1:1	4	RT		AN	85	VN	15	0.05		0.1			0.05		bmli	0.6			Bynel, 35 µm	Pt-FTO					
0.3	sat. acid in CB	5	RT		AN	85	VN	15	0.03		0.05			0.5		dmli	1			25 µm Surlyn	Pt-FTO				hole drilling by an ultrafine sandblaster, vacuum backfilling, Bynel for hole sealing	
0.2	ethanol	2																							0.05 M hexachloroplatinic acid	
0.3	sat. acid in CB	5	RT		pmii	65	EMIB(CN) <sub>4</sub>	35	0.2							NBB	0.5	GuNCS	0.1							
									1.67%											25 µm Surlyn	Pt-FTO					hole drilling by an ultrafine sandblaster, vacuum backfilling, Bynel for hole sealing
	AN				CB	95	AN	5	0.17			50	29.4							Sb dopant	3.30E-04	AN	0.96	Au	evap.	semitransparent
0.5	AN-i-butanol 1:1	8	RT		CB	100			0.17			27	27.0	0.18	105.88	Sb dopant	7.60E-04	AN	0.96	Au					silver stripes to enhance current collection, sealed with glass and Surlyn and Torr Seal	
0.5	AN-i-butanol 1:1			Bu <sub>4</sub> N <sup>+</sup> dcbpyH <sub>2</sub>	CB	100			0.1			27	27.0	0.11	110.00	Sb dopant	2.00E-04	VN	0.11	Au						
0.5	AN-i-butanol 1:1			silver nitrate (50 mol-% of c afterw. rinsed w. ethanol)	CB	100			0.1			27	27.0	0.11	110.00	Sb dopant	2.00E-04	VN	0.11	Au						
0.2	THF	0. n.			CB	100			0.17		Li triflate:	13	7.6	0.13	76.47	Sb dopant	3.00E-04									Li triflate inst. Li salt
0.2	THF	0. n.			CB	100			0.17		Li triflate:	13	7.6	0.13	76.47	Sb dopant	3.00E-04									Li triflate inst. Li salt
0.5	AN-i-butanol 1:1	1			CB	100			yes		yes	yes	yes	yes	Sb dopant	yes										1 min penetration of Spiro-solution, dried for 30 min in Ar-flow and evacuated at -5x10 <sup>-6</sup> mbar
0.3	AN-i-butanol 1:1			silver nitrate	CB	100			yes		yes	yes	yes	yes	Sb dopant	yes										
0.3	AN-i-butanol 1:1	RT			CB	100			0.17		13	7.6	0.13	76.47	Sb dopant	3.00E-04										
6	GBA : MP 1:1	10 min	RT	rinsed with AN	CB	100	(AN)	(1.5)	0.15			8.7	0.047													
0.3	AN-i-butanol 1:1				CB	100	(AN)	(2.6)	0.15			21.9	14.6	0.12	80.00	Sb dopant	8.60E-03	AN	0.50							evap. at 10 <sup>-6</sup> mbar
0.5	AN-i-butanol 1:1				CB	100	(AN)	(1.5)	0.15			8.7	5.8	0.047	31.33											
1	AN-i-butanol 1:1	12	RT		CB	100			0.17			19.5	11.5	0.12	70.59											
					CB	100			0.18			0.21	0.1	0.11	61.11	Sb dopant	2.60E-04									
0.3	ethanol	15	RT		CB	100			yes		yes															
0.5	AN-i-butanol 1:1	2h	60	rinsed with AN-i-butanol	CB	100	(AN)	(2.2)	0.17			13	7.6	0.12	80.00											
0.1 (100 µl)	THF	sprayed	RT (110)	n-heptane post-treatment	CB	100	(AN)	(2.2)	0.17			13	7.6	0.12	80.00					AN	0.42					7 months old ss-DSSC (slight degradation) with kink in I-V curve
					CB	100			yes		yes															7 months old coarse-porous dye aggregate solar cell (DASC) with kink in I-V curve, n-heptane treatment: 4 h at 110 °C
					CB	100			yes		yes															
					CB	100			2.55		yes															
					CB	100			yes		yes															
					CB	100			yes		yes															
0.3	sat. acid in CB	5	RT		CB	100			0.17		0.21	0.1	0.00011 ?	0.06												
					CB	100			0.17		13	7.6	0.11	64.71												

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