Photophysical Properties, Photoluminescence and Electroluminescence in Novel Luminescent Polysilanes and their Blends

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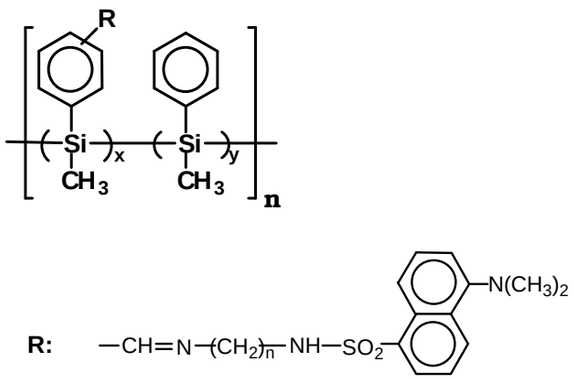
The performance of polymer light-emitting diodes (LEDs) has improved dramatically over the recent decade. We have shown that the performance of polymer LEDs, specifically the electroluminescent efficiency and time stability, can be improved by optimizing the parameters of the active medium through polymer blending [1-4]. Recently, using polymer blends based on polyfluorenes (PFs) and modified polysilanes we managed to obtain an increase in the EL efficiency of up to two orders [3]. The EL results were explained mainly by modification of charge transport and recombination in the polymer layer.

In this contribution, we will present results of photophysical study, photoluminescence (PL), electroluminescence (EL) and charge photogeneration in novel luminescent polysilanes and their blends with luminescent conjugated polymers (poly-*p*-phenylenes, polyfluorenes). We prepared novel modified polysilanes (PMPSi-n-DNS, where n = 0, 2, 5, 8, 12, see Scheme 1) by attachment of dansyl moieties, 5-(dimethylamino)-naphthalene-1-sulfonohydrazide or *N*-(ω-aminoalkyl)-5-(dimethylamino)naphthalene-1-sulfonamide, to formylated poly[methyl(phenyl)silanediyl] (PMPSi) by condensation of the aldehyde with primary amines yielding Schiff bases. The aldehyde groups were introduced into the parent PMPSi by the reaction with dichloromethyl methyl ether in the presence of a Lewis acid ($SnCl_4$) [5].



Scheme 1. Structure of substituted polysilanes PMPSi-n-DNS (n = 0, 2, 5, 8, 12).

Stationary and time-resolved PL was measured. Broad-band PL emission with maxima located at 470 – 490 nm was observed in thin polymer films (see Figure 1). Sharp near-ultraviolet emission of PMPSi at 350 – 360 nm was not detected in modified polymers, which indicates that an efficient energy transfer from PMPSi to dansyl derivatives occur. This was shown also in a time-resolved PL study. The modified polysilanes exhibited better photostability than PMPSi and were utilized for preparation of polymer light-emitting devices. Single- and double-layer LEDs with emission in visible spectral region were prepared from the neat polysilanes and their blends. Emission and electrical characteristics were studied and will be discussed. In addition to the PL and EL, the charge photogeneration was investigated using the method of photoinduced surface potential decay.

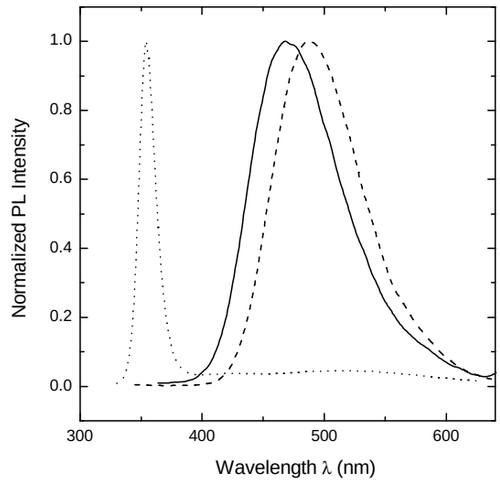


Figure 1. PL emission spectra of thin polymer films made of: PMPSi (dotted line) and modified PMPSi: by PMPSi-0-DNS (dashed line) and by PMPSi-8-DNS (solid line).

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[1] V. Cimrová, D. Neher, M. Remmers, I. Kmínek, Adv. Mater. 10 (1998) 676.
[2] V. Cimrová, D. Výprachtický, J. Pecka, R. Kotva, Proc. SPIE – Int. Soc. Opt. Eng. 3939 (2000) 164.
[3] V. Cimrová and D. Výprachtický, Appl. Phys. Lett 82 (2003) 642.
[4] V. Cimrová and D. Výprachtický, Macromol. Symp. 212 (2004) 281.
[5] D. Výprachtický and V. Cimrová, Macromolecules 35 (2002) 3463.