Nanocomposites and nanomaterials

Thermally stimulated luminescence of silicon organic polymers and nanocomposites

N. Ostapenko, O. Kerita, Yu. Ostapenko

Institute of Physics, NAS of Ukraine,
Prospect Nauki, 46, Kyiv 03068, Ukraine.
*E-mail:*kerita@ukr.net

The low temperature thermally stimulated luminescence (TSL) studies provide important information about the presence and activation energies of traps and defects for charge carriers in silicon organic polymers that are promising materials for transport and luminescent layers [1] in optoelectronic devices.

Here we present the results of comparative TSL study of the poly(di-n-hexylsilane) (PDHS) polymer film, solutions and nanocomposites in the temperature range of 5–120 K. The PDHS/MCM-41 and PDHS/SBA-15 nanocomposites were prepared by introducing polymer into MCM-41 or SBA-15 nanoporous silica matrices with different pore diameters (2.8 and 9 nm, respectively). It was shown that by changing the pore size we can control a set of charge carriers traps with the required distribution of activation energies.

It was found that TSL curve of the PDHS/SBA-15 nanocomposite shifts to lower temperature by 25 K comparing with that of the polymer film. This indicates a significant reduction in the number of deep traps with shorter polymer segments and large activation energy.

TSL curve of the PDHS/MCM-41 nanocomposite is observed in a narrow temperature range and is shifted to lower temperatures by 8 K comparing with that of the PDHS/SBA-15 nanocomposite. It shows the structure consisting of two bands: a narrow band with maximum at 17 K and a weaker broader band centered at 28 K. Since only one polymer chain could be accommodated inside MCM-41 pore, the TSL curve must be significantly shifted to lower temperatures comparing with that of the PDHS/SBA-15 nanocomposite, and this is observed experimentally. We assume that the narrow TSL band centered at 17 K is associated with the charge release from shallow traps (oriented long polymer segments) with smaller activation energy. This well agrees with the fact that the TSL curve of dilute PDHS solution coincides with TSL curve of PDHS/MCM-41 nanocomposite.

1. *Sharma A., Katiyar M., Deepak, Seki S., Tagawa S.* Room temperature ultraviolet emission at 357 nm from polysilane based organic light emitting diode // Appl Phys Lett.-2006.-**8.** -P.143511-143513.