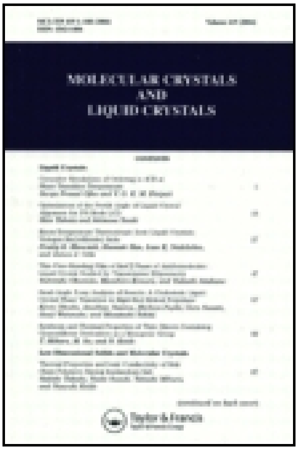

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Polysilane Photoluminescence Specific to Oriented Thin Films

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Polysilane Photoluminescence Specific to Oriented Thin Films

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Highly oriented ultrathin films of poly (dimethylsilylene) and poly (diethylsilylene) were prepared by friction-transfer technique. Photoluminescence spectra of the films were different from those of powder sample. The luminescence peak of thin film was observed at 10nm shorter wavelength than that of powder. The difference remained from −200° C to 250° C.

Keywords: polysilane; orientation; thin film; photoluminescence

INTRODUCTION

Polysilanes are polymers whose main chains are composed of only silicon atoms. Their optical and electronic properties are caused by the delocalization of σ-electron in the Si-Si bonds. They are expected to be materials for opto-electronics. Fabrication of the thin film is an improtant technique for the usage of polysilane to the devices. We could prepare highly oriented thin films of polysilanes, such as poly (dimethylsilylene) (PDMS) [1], by friction transfer method, and studied structure and properties of the film [2]. In this work, we observed the photoluminescence specific to the thin film.

EXPERIMENTALS

Materials

Oriented thin films of polysilanes were made by friction transfer technique[3] ,as following. Pellet of polysilane was pressed on the smooth substrate with constant pressure, and it was slid straight along an direction on the substrate, whose temperature was controlled, under nitrogen atmosphere. Then, thin film of polysilane was formed on the substrate.

Measurements

Photoluminescence (PL) spectra of the thin film and powder specimen of polysilanes were measured.

RESULTS AND DISCUSSION

Photoluminescence Spectra of Thin Films

PL spectra of PDMS thin films, which were prepared by friction transfer technique, were different from those of powder sample. Figure 1 shows the comparison between the PL spectra of thin film and powder sample. The PL peak of powder sample was observed at 363nm. However, the PL peak of the thin film prepared at 214℃ was observed at 352nm. The PL peak of the thin film was shifted to 10nm shorter wavelength from that of the powder sample. The spectral peak width of the thin film was narrower than that of the powder.

Closely observed, PL spectrum of the thin film composed of two components.

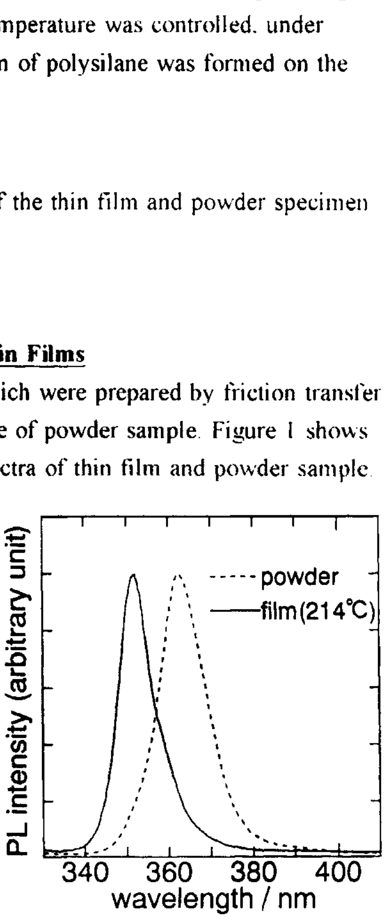

FIGURE 1 PL spectra of PDMS

One is a strong sharp band peaked at 352nm and the other is a small band which was also observed in the spectrum of powder sample at longer wavelength.

The polarized PL spectra of PDMS thin film were measured. The strong band peaked at shorter wavelength was strongly polarized, while, the other small component at longer wavelength of the spectra was weakly polarized. The band observed in only thin films seems to be strongly related with orientation.

The PL spectrum specific to the thin film was also observed in poly(diethylsilylene) (PDES). Figure 2 shows the PL spectra of PDES thin film and powder. The PL peak of powder was observed at 381nm. The PL spectrum of oriented thin film prepared at 210℃ peaked at 372nm.

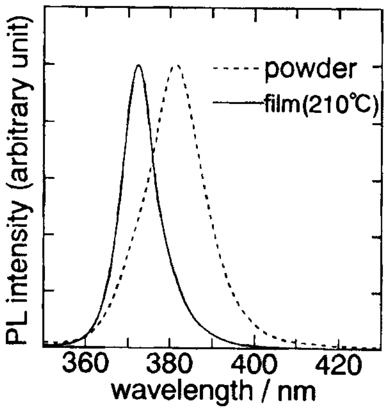

FIGURE 2 PL spectra of PDES.

Temperature Dependence of Photoluminescence Spectra

In order to investigate the origin of the difference between oriented thin film and powder, temperature dependence of PL spectra were measured. Figure 3 shows the peak wavelength of the PL spectra of the powder and the film prepared at 240℃ in the temperature from -200 to 250℃. PL peaks were shifted from shorter wavelength to longer one as the temperature was raised. The difference of the peak wavelength between the powder and the film sample was kept in whole temperature range.

X-ray diffraction study revealed PDMS has three solid phases [4]. Oriented thin film was the same crystal structure as the powder, and was also found to go through the phase transitions by X-ray diffraction. The difference of PL spectra was remained even though the samples underwent the phase transitions. This suggests that the difference of PL spectra did not arise from the difference in crystal and molecular structures. The newly observed band specific to thin films was speculated to be originated from some interaction between oriented molecular chains.

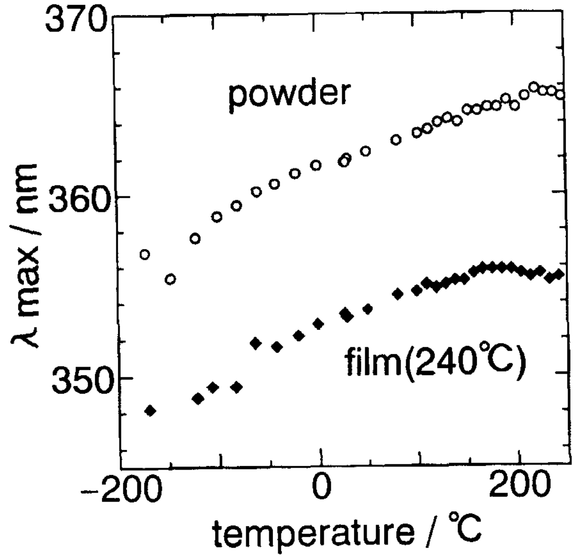

FIGURE 3 Temperature dependence of PL peaks of PDMS.

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