

## Pressure-Induced Changes in Phosphorescence Behavior of Polyimide Films

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### ABSTRACT:

We have recently reported that semi-aromatic polyimide (PI) films containing heavy halogens such as bromine and iodine at the dianhydride moieties exhibit room-temperature phosphorescence (RTP). The photo-luminescence properties of PIs are changed by applying pressure as external stimulus due to densification of aggregation structure of PI chains. In this study, pressure-induced variations in photoluminescence properties of a semi-aromatic PI consisting of 3-bromopyromellitic dianhydride and 4,4'-diaminocyclohexylmethane (3BPMDA/DCHM) were examined by photoluminescence spectroscopy under very high pressure up to 8 GPa using a diamond unil cell (DAC). The emission spectrum of 3BPMDA/DCHM at atmospheric pressure shows dual emission attributable to the fluorescence derived from aggregated PI chains and the phosphorescence derived from isolated PI chain, respectively. The fluorescence and phosphorescence intensities of 3BPMDA/DCHM were significantly reduced by applying pressure up to 2 GPa (low pressure range). This phenomenon is attributable to an enhanced non-radiative deactivation process induced by reduction in inter-molecular distances. Furthermore, the phosphorescence intensity was more significantly decreased than the fluorescence intensity in the low pressure range, which implies that the degree of reduction in fluorescence was suppressed by an increase in aggregated PI chains having fluorescent ability. Accordingly, analysis of photoluminescence properties of PIs under very high pressure is an effective method for examining the influence of the variations in aggregation structures on the fluorescence and phosphorescence properties.

Keywords: Polyimide, Fluorescence, Phosphorescence, Aggregation Structures, High Pressure