Triboluminescence of luminophores in blended polymers: simple preparation method for triboluminescent films

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Triboluminescent materials, which produce emission of light by mechanical actions, are attractive components for smart materials and mechanical sensors. In order to produce triboluminescence (TL) in luminophores, piezoelectric (non-centrosymmetric) crystal structure has been proposed for a factor to generate electric field by mechanical stimuli, which leads to the excitation of luminophore. During our study on TL of a family of photoluminescent [(pyridinophane)Cu^{I}(NHC)]X complexes, we found that both centrosymmetric and non-centrosymmetric crystals show intense TL.[1] And TL of the Cu^{I} complexes was also observed even in amorphous polymers, which inspired us to establish a new concept to produce triboluminescent materials by utilizing common luminophores and polymers. To the best of our knowledge, we for the first time demonstrate that triboluminescent films can be obtained by simply blending common luminophores and polymers without crystalline formation of luminophores. Representative nine luminophores, which show fluorescence or phosphorescence, were selected and physically mixed with poly(methylmethacrylate) (PMMA) to provide amorphous films. (Figure 1) TL of the luminophores in PMMAs were observed by rubbing the surface under inert atmosphere, in spite of the TL property of the luminophores in the crystals. The photographs of TL generated by rubbing the surface of the PMMAs containing the luminophores (5–15 wt%) using glass rod under Ar are shown in Figure 1. PXRD analysis and fluorescence microscopy images confirmed the absence of crystalline form and nano/micro particles of the luminophores in the PMMAs. The TL spectra of the PMMAs (1 wt%) show photoluminescence of each luminophore and Ar gas plasma emission, which imply gas discharging by triboelectrification. TL is also observed in polystyrene, polycaprolactone, poly(vinyl chloride), and polycarbonate. TL of the luminophores in crystal as well as influence of surrounding gas on TL will also be discussed in the presentation.

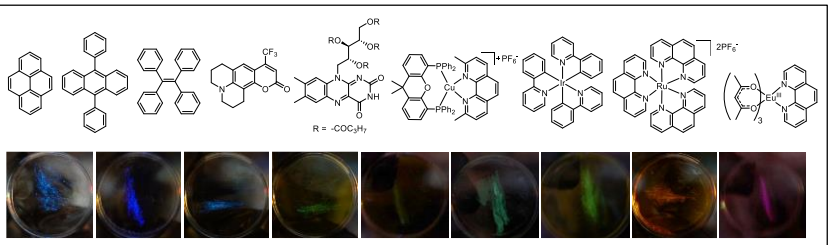

Figure 1. Chemical structures of luminophores and photographs of the TL in PMMA (5–15 wt%) under Ar.

1) A. Karimata, P. H. Patil, R. R. Fayzullin, E. Khaskin, S. Lapointe, J. R. Khusnutdinova, *Chem. Sci.* **2020**, *11*, 10814.