

# Creation of Stimuli-Responsive Fluorescent Liquid Materials for Anti-Counterfeiting

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## Creations of stimuli-responsive fluorescent liquid materials

Fluorescent materials used as organic light-emitting diodes (OLEDs) are generally composed of p-conjugated molecules based benzene rings. These p-conjugated molecules adapt solid states because these molecules strongly interaction with one another. These materials are used as thin films to apply into devices such as OLEDs. If we obtain p-conjugated materials in various states including liquid states, expansion of uses for these materials is expected in the various areas. However, it is difficult to design and prepare room-temperature liquid materials based on p-conjugated molecules, and there are few reports all over the world. Recently, we have prepared stimuli-responsive fluorescent liquid materials (SFLs) at room temperature based on our concepts and designs. To the best of our knowledge, this is the first report on N-heteroacene-based SFLs.<sup>1-5</sup>

We have developed a series of SFLs in response to acid substances such as HCl gas, of which emission colors dramatically change from blue to green, yellow, and orange. Figure 1 displays stimuli-responsive liquid materials developed by our group, which can be used as inks to write literatures onto papers. Unlike inks commercial available, an exposure to HCl vapor can bring about remarkable changes of inks in emission colors. In Figure 1, emission colors of both literatures are changed from blue to green or yellow by exposure to HCl vapor. Then, the emission color can be recovered into the initial state (upper). On the other hand, the other does not change (lower), whereas can be recovered by an exposure to NH<sub>3</sub> gas, heating and so on. The combination use of both inks for security documents can increase the security level, which can be expected to inhibit distribution of counterfeiting products.

References.

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4. K. Isoda,\* *et al.*, *ACS Appl. Mater. Interface*, **2019**, *11*, 12053–12062.
5. K. Isoda, M. Matsubara, A. Ikenaga, Y. Akiyama, *J. Mater. Chem. C*, **2019**, *7*, 14075–14079.

## Stimuli-Responsive Liquid Materials

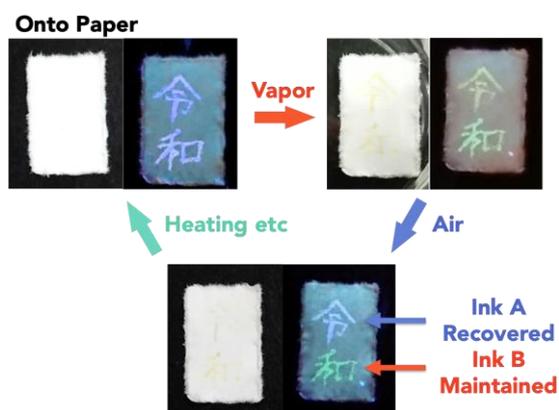


Figure 1. Stimuli-responsive behaviors of liquid materials.

Left: Room Light, Right: Black Light.

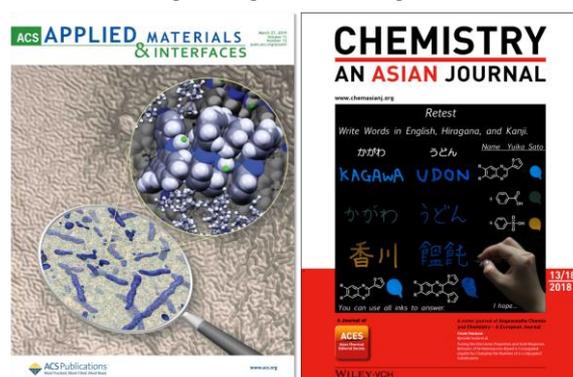


Figure 2. Cover pictures of Refs. 4 and 2.