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Bridged Stilbenes: AIEgens Designed via a Simple Strategy to Control the Non-radiative Decay Pathway

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**Bridged Stilbenes: AIEgens Designed via a Simple Strategy to Control the Non-radiative Decay Pathway**


Celebration for the 20th anniversary of aggregation-induced emission (AIE)

**Abstract:** To broaden the application of aggregation-induced emission (AIE) luminogens (AIEgens), the design of novel small-molecular dyes that exhibit high fluorescence quantum yield ($\Phi$) in the solid state is required. Considering that the mechanism of AIE can be rationalized based on steric avoidance of non-radiative decay pathways, a series of bridged stilbenes was designed, and their non-radiative decay pathways were investigated theoretically. Bridged stilbenes with short alkyl chains exhibited a strong fluorescence emission in solution and in the solid state, while bridged stilbenes with long alkyl chains exhibited AIE. Based on this theoretical prediction, we developed the bridged stilbenes BPST[7] and DPB[7], which demonstrate excellent AIE behaviour.

**Introduction**

Over the last two decades, aggregation-induced emission (AIE)[1] has contributed to great developments in the fields of materials science,[2] analytical chemistry,[3] and life sciences.[4] In addition to conventional AIE-active compounds, such as derivatives of tetraarylsilole[5] and tetraphenylethene,[6] recent studies have found a wide variety of new AIE-active compounds. However, to further broaden the potential applications of AIE luminogens (AIEgens), the design of novel small-molecular dyes that also exhibit high fluorescence quantum yields ($\Phi$) in the solid state is required. The mechanism of AIE has been thoroughly investigated, which allows us to approach this task via rational molecular design. The characteristic phenomenon observed in AIEgens, i.e., quenching in solution and emitting light in the solid state, can be explained either by the ‘restriction of intramolecular rotation’ (RIR) model, the ‘restriction of intramolecular motion’ (RIM) model,[7] or by the ‘restricted access to conical intersection’ (RACI) model.[8]

In our previous studies, we discovered that bis(N,N-dialkylamino)anthracenes (BDAA$s$) display AIE.[9,10] We have reported that the mechanism of AIE for BDAA$s$ can be explained as follows: 1) the ring-puckered conical intersection (CI) is lowered in energy via rotation of the amino group, which leads to internal conversion rather than emission in solution; 2) fast internal conversion in solution results in a low $\Phi$ in solution; 3) given that ring puckering is prohibited in aggregated states, internal conversion is inhibited and therefore the $\Phi$ in aggregated states is enhanced.[10] The term “aggregation-induced emission” refers to the induction of luminescence when aggregates form in solution. This definition does not include explanation of the non-radiative decay in solution. From the theoretical investigation of the photophysical processes of BDAA$s$ exhibiting AIE behavior in a single molecule,[10] we concluded that the essence of AIE should be explained by the “environment-responsive non-radiative decay” model, rather than an ambiguous phenomenology which involves obtaining luminescence by decreasing mobility in the aggregate state. Therefore, the rational design strategy for AIEgens from the viewpoint of theoretical chemistry is the control of conical intersection accessibility (CCIA).

The rational molecular design of AIEgens based on the RACI model or CCIA strategy has so far been limited to the design of dialkylaminorenare derivatives.[10,11] In the present study, we propose a paradigm shift in AIEgen design. Recent theoretical investigations have revealed that it is possible to analyze photophysical processes using a potential energy surface (PES) in the same manner as a classical thermal chemical reaction.[12] Controlling access to the CI enables the selective formation of fluorescent and non-fluorescent molecules, as if controlling access to the transition states determine reaction rate and selectivity of products. AIEgens that arise from the CCIA strategy should satisfy the following three conditions: 1) a CI that is low in energy whilst in solution in order to ensure that the AIEgen has a low $\Phi$ in solution; 2) a non-radiative decay pathway that is inhibited by the surrounding molecules when the AIEgen is in the solid state or an aggregate. The AIEgen should also possess a molecular motion of large amplitude that gives rise to a non-radiative decay pathway; 3) the orbital overlap in the aggregate form should be low in order to avoid aggregation-caused quenching (ACQ).

Thus, by identifying the non-radiative decay pathway of the AIEgen, one can understand how an AIEgen acquires a low $\Phi$ in solution and a high $\Phi$ in the aggregate form. Therefore, the rational design of AIEgens that arise from the CCIA strategy can be realized as follows: 1) search for π-conjugated systems as molecular core with known...
non-radiative decay pathways; 2) structurally or electronically tune the system to lower the CI of the molecule; 3) design the molecular structure so that its non-radiative decay pathway has a molecular motion with large amplitude. In contrast, the molecular design of AIEgens using the RIR or RIM model aims to suppress the non-radiative decay pathway of the molecule in the solid state. This is achieved via introduction of a large number of biaryl bonds or a bridged structure between neighboring aryl groups to a molecular core. The design strategy that we employ here attempts to determine the non-radiative decay pathway in advance, before we introduce bulky groups at a specific position so that this pathway is blocked in the solid state. Using this strategy, we can identify prospective AIEgens via theoretical calculations and subsequently develop simple high-performance AIEgens.

We chose a π-extended stilbene as the molecular skeleton, as the non-radiative decay pathway of stilbene and that of tetraphenylethene (TPE) proceeds via flipping of the double bond. Accordingly, we focused on this pathway and designed a molecule that is mechanically constrained around the stilbene double bond. This approach allowed us to control the energy level of the CI of the stilbene moiety. As reported previously by bridging one end of the C=C bond to one of the two phenyl rings, it is possible to create a structure similar to that of indene. The formation of this tightly twisted C=C structure is not energetically favorable and destabilizes the CI. The corresponding dye exhibits a high-energy CI, which renders the non-radiative decay less likely to occur. Consequently, the dye exhibits strong fluorescence in solution and in the solid state.

In this study, we investigated the photophysical properties of a series of stilbenes and bridged stilbenes. We calculated the non-radiative decay pathway of stilbene [13] and that of π-extended stilbenes as the molecular skeleton, as the non-radiative decay pathway of stilbene and that of tetraphenylethene (TPE) proceeds via flipping of the double bond. Accordingly, we focused on this pathway and designed a molecule that is mechanically constrained around the stilbene double bond. This approach allowed us to control the energy level of the CI of the stilbene moiety. As reported previously, by bridging one end of the C=C bond to one of the two phenyl rings, it is possible to create a structure similar to that of indene. The formation of this tightly twisted C=C structure is not energetically favorable and destabilizes the CI. The corresponding dye exhibits a high-energy CI, which renders the non-radiative decay less likely to occur. Consequently, the dye exhibits strong fluorescence in solution and in the solid state.

Theoretical Investigation of the Non-radiative Decay pathway for the Stilbenes and the Bridged Stilbenes

In the beginning, we determined the non-radiative decay pathway of stilbene (ST). It should be noted that a twisted-pyramidal conical intersection has been reported on the PES of stilbene [13]. The minimum energy conical intersections (MECs) of ST were calculated using spin-flip time-dependent density functional theory (TD-DFT) at the Becke-Half-and-Half LYP/6-31G+(d) level of theory using the branching-plane-updating method. The Franck-Condon state (FC), the local minimum near the FC (S1min), and the intermediate near the CI (INT) were located using the same method. The transition state (TS) connecting S1min and INT was initially located at the TD-B3LYP/6-31+G(d) level of theory, but subsequently updated to the SFTD-BHHLYP/6-31G+(d) level of theory using TD-B3LYP Hessian matrix calculations. All calculations were performed using GAMESS (2019 Sep.) and Gaussian 16.C01 [17,18].

Results and Discussion

Initially, we investigated the photophysical properties of a series of stilbenes and bridged stilbenes. We calculated the photophysical properties, synthesized the compounds (Figure 1), experimentally measured their photophysical properties, and compared the experimental results with those of the theoretical calculations.

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We located the CI of ST and connected the most important points on the PES. As shown in Figure 2(a), excited ST initially relaxes to a local minimum (S1min), where fluorescence occurs with an oscillator strength of ~0.6. After passing through a low barrier (7.88 kJ/mol), an intermediate structure INT is formed near to the CI. This structure has a small oscillator strength (~0.01), and thus this state can be thought of as a “dark state”. After passing the INT, the S1/S0 MECI was found at 25.16 kJ/mol higher than the S1min. The structure of the MECI is a typical twisted-pyramidal structure (Figure 3). Note that this type of CI can lead E/Z isomerization. Because whether which isomer generates after passing through CI does not affect to the

Figure 1. Structures of stilbenes and bridged-stilbenes.

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fluorescence quantum yield, we do not show isomerization pathway in the figure.

To govern the photophysical properties of an AIEgen, the non-radiative decay pathway needs to be controlled. In the case of stilbene-based molecules, the simplest approach to achieve this is to mechanically restrict the twisting angle of the C=C bond. With this in mind, we considered a different series of compounds based around a bridged stilbene core (BST\[n\]). Here, \( n \) denotes the size of the \( n \)-membered ring used to restrict the movement of the C=C bond. Depending on the length of the alkyl chain, bridging phenyl groups gradually restrict the twisting angle of the C=C bond.

Subsequently, we calculated the non-radiative decay pathways for BST[5], BST[6], and BST[7], and Figure 2(b) shows the energy diagram for the non-radiative decay process for each of these compounds. The FC for BST[7] is higher in energy than that of BST[5] and BST[6], which can be rationalized in terms of the planarity of the \( \pi \)-conjugation observed in these molecules. In contrast to planar BST[5], BST[6] and BST[7] exhibit a phenyl group that is shifted out of the plane (Table 1). This shift causes a decrease in planarity of the molecule, which reduces the effective conjugation length, especially in BST[7] (Figure 4), and thus causes a shorter absorption wavelength.

![Figure 2](image-url)

**Figure 2.** Energy diagram of (a) ST and PST, (b) bridged-stilbene BST\[n\], and (c) bridged-phenylstilbene BPST\[n\].

![Figure 4](image-url)

**Figure 4** Structure of BST[7] in the FC state.

**Table 1.** Geometrical parameters of BST\[n]°

<table>
<thead>
<tr>
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<td>1-2-3-4</td>
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<tr>
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<td>0.0</td>
<td>2-3-4-5</td>
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<td>149.7</td>
<td>180.0</td>
<td>3-4-5-6</td>
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</table>

*The atom-numbering scheme is shown in Figure 3.
The energy of the MECIs descends in the order BST[5] > BST[6] > BST[7]. Although all these structures are similar, the shorter alkyl chain found in BST[5] is more rigid than those found in BST[6] and BST[7], and thus raises the energy of the twisted-pyramidal CI (Figure 3). Conversely, the longer alkyl chains observed in BST[6] and BST[7] keep the energy of the CI low. A similar trend can be observed in the calculated $\Phi_n$ in solution. The low barrier required to form the twisted-pyramidal MECI in BST[7] (9.59 kJ/mol) would suggest that BST[7] easily undergoes non-radiative decay, which would amount to a low $\Phi_n$ in solution. Conversely, the PES of BST[6] is different from that of BST[7], i.e., the MECI for BST[6] resides at an energy level that is 43.26 kJ/mol higher than that of the S1min, which is still under the CI low. A similar trend can be observed in the calculated $\Phi_n$ and $\lambda_n$ for BST[6] would be smaller than BST[7] and $\Phi_n$ for BST[6] would be larger than BST[7]. The MECI of BST[5] is so high that it can be feasible expected that its non-radiative decay is very difficult to take place. In summary, it can be expected on the basis of the results of the theoretical calculations carried out in this study that the low MECI of BST[7] would render BST[7] a good prospective core structure for advanced AIEgens. BST[7] can be expected to have an accessible non-radiative decay pathway due to a large-amplitude molecular motion and therefore exhibit a low $\Phi_n$ in solution.

As the calculated fluorescence wavelength of the BST[n] series is too short, we also considered bridged π-extended stilbenes (BPST[n]) to achieve emission at visible wavelengths. The calculated fluorescence wavelength of BPST[7] (370 nm) is within the visible region. The energy diagram for the BPST[n] series follows the same trend as that of the BST[n] series. Therefore, BPST[7] would be expected to be a good AIEgen candidate. A more detailed discussion of the energy diagrams is given later (vide infra).

Photophysical Properties of the Bridged Stilbenes

The structures and photophysical properties (absorption, fluorescence in solution and the solid state (polycrystalline solids), as well as $\Phi_n$ values) of the synthesized stilbenes and bridged stilbenes are summarized in Figures 1 and S48 and Table 2. The synthetic methods used and all characterization data, including all spectra, are listed in the Supplementary Information. In some cases, the general synthetic route was not feasible. In the case of BPST[7], when 4-biphenylyboronic acid was used in the Suzuki-Miyaura cross-coupling reaction,\[^{[19]}\] a quaterphenyl, a compound that shows strong fluorescence in solution, was obtained as a byproduct. In order to avoid the formation of p-quaterphenyl, we performed a stepwise addition of the benzene rings.

We first examined a series of compounds that contains just two benzene rings, i.e., ST and BST[n]. While ST exhibits typical AIE behavior (\(\Phi_{sol} = 0.01; \Phi_{solid} = 0.62\)), BST[5] shows a strong fluorescence in the UV region in solution and in the solid state (\(\Phi_{sol} = 0.40; \Phi_{solid} = 0.79\)), BST[6], which contains a more flexible alkyl chain, exhibits aggregation-induced emission enhancement (AIEE) behavior (\(\Phi_{sol} = 0.06; \Phi_{solid} = 0.26\)). While BST[7] is unfortunately a liquid at room temperature, BST[7]-**Bu is a solid and shows AIE behavior. However, the fluorescence of the BST derivatives is in the UV region and, especially from an analytical and materials science perspective, fluorescence in the visible region is preferable. Therefore, we decided to examine bridged stilbenes with π-extended structures.

Subsequently, we examined a series of compounds that contain three benzene rings, 4-phenylstilbene (PST) and BPST[n], and found that the extended π-conjugation observed in these molecules greatly affects their absorbance and fluorescence properties.

The shapes and vibrational structures of the absorption and fluorescence spectra of BST[n] are similar to previously reported spectra of ST and the π-extended ST, poly(p-phenylene-vinylene).\[^{[20]}\] PST and BPST[n] are related in a similar fashion. Accordingly, the lowest energy absorptions of PST and BPST[n] (\(n = 5-7\)) can be assigned to the allowed 'Ag → 1Bu transition.\[^{[22]}\]

Comparing the maximum absorption wavelengths (\(\lambda_{max}\)) of PST and BPST[n] in solution; only BPST[n] exhibits a large hypsochromic shift. In contrast, the maximum fluorescence wavelengths (\(\lambda_f\)) of PST and BPST[n] remain virtually unchanged. The large Stokes shifts (7200 cm\(^{-1}\)) observed for BPST[7] is in good agreement with the calculated results (Figure 2b). The FC state of BPST[7] is higher than that of BPST[5] and BPST[6], albeit that the S1min state of all these compounds are similar. The structural change between the FC and S1min states of BPST[7] was confirmed by quantum calculations (Figure S57).

Diffuse-reflectance and fluorescence spectra of polycrystalline PST and BPST[n] are shown in Figure S50. Both the \(\lambda_{max}\) and \(\lambda_f\) values of polycrystalline PST and BPST[n] are bathochromically shifted relative to those in dilute solution. The same phenomenon has been reported for the prototypical AIEgen tetrphenylethene (TPE).\[^{[8]}\] In the case of BPST[n], intermolecular electronic interactions or conformational changes such as planarization-induced π-extension can be expected, which we will discuss during the x-ray crystallographic analysis (vide infra).

Unlike ST, PST exhibit strong fluorescence in the blue region of the visible spectrum in solution and the solid state (\(\Phi_{sol} = 0.64; \Phi_{solid} = 0.72\)), i.e., PST is unlike ST not an AIEgen. Similarly, BPST[5] and BPST[6] emit light in solution and the solid state. In contrast, BPST[7] shows perfect AIE behavior (\(\Phi_{sol} = 0.01; \Phi_{solid} = 0.95\)) with negligible emission in solution and high emission in the solid state. DPB[7], which extends the π-conjugation of the system from a different position to BPST[7], also shows excellent AIE properties (\(\Phi_{sol} = 0.02; \Phi_{solid} = 0.75\)). However, BPST[8] showed little fluorescence in solution or in the solid state (\(\Phi_{sol} = 0.004; \Phi_{solid} = 0.04\)). In regards to the absorption spectrum (\(\lambda_{abs}\)), compared to PST, BPST[5] has increased planarity and shows longer π-conjugation length, BPST[6] has a similar degree of increased planarity, and both BPST[7] and [8] has decreased planarit and exhibits shorter π-conjugation length. The effect is reflected in the fluorescence spectra of these molecules (Table 2), i.e., \(\lambda_{abs}\) decreases with decreasing planarity of the molecule. BPST[8] exhibits not only the smallest \(\lambda_{abs}\), but also the smallest absorption coefficient (c), which is most likely due to a large twist around its C=C double bond. The shape of the fluorescence spectra of polycrystalline BPST[8] is similar to those of BPST[n] (\(n = 5-7\)), albeit that the \(\Phi_n\) is very small (< 0.01). The reasons why BPST[8] does not exhibit fluorescence, neither in solution nor the solid, are that the
twisted structure is sufficiently large and that the conjugated system does not spread. In other words, this behavior can be explained by its twisted structure, which leads relatively smaller oscillator strength besides high accessibility toward MECI. Based on the results of the fluorescence spectra, it can be concluded that the flexible bridge provided by a 7-membered ring leads to the desired AIE effect in PST.

We have also measured the fluorescence lifetime of PST and BPST[n] (n = 5-7) in THF and determined the non-radiative ($k_{nr}$) and radiative transition rates ($k_r$) (Table S2). The obtained $k_{nr}$ of PST and BPST[n] (n = 5-7) are $3.3 \times 10^8$, $0.9 \times 10^8$, $1.4 \times 10^8$, and $3.7 \times 10^8$ [s⁻¹], respectively. The $k_r$ of PST and BPST[n] (n = 5-7) are $8.0 \times 10^8$, $7.2 \times 10^8$, $6.6 \times 10^8$, and $4.8 \times 10^8$ [s⁻¹], respectively. Among these compounds, BPST[7] shows $k_r \ll k_{nr}$, while the other dyes exhibit $k_r \gg k_{nr}$. In other words, the reason that BPST[7] shows very weak fluorescence is due to its high $k_{nr}$.

Comparing PST, BPST[5], and BPST[6] with BPST[7] shows that the $k_{nr}$ value of the latter is large albeit that the $\epsilon$ and $k_r$ values are small. Therefore, the conformation of BPST[7] does not decrease the planarity and restrict the mode leading to MECI.

An aggregation experiment of BPST[7] was performed, albeit that the $\Phi_{fl}$ value was low (0.22). Furthermore, the fluorescence wavelength ($\lambda_{max}$) is shorter than that of the solid due to the shorter lengths of the aggregates of the conjugated system (Table S1).

4,4'-Diphenylstilbene (DPST) contains four benzene rings and shows strong fluorescence in solution, which is quenched by intermolecular interactions in the solid state ($\Phi_{sol} = 0.67$; $\Phi_{solid} = 0.16$). The fluorescence behavior of DPST is similar to that of poly(p-phenylene vinylene) (PPV).[23] In contrast, the bridged form of DPST, BDPST[7], shows AIEE behavior ($\Phi_{sol} = 0.12$; $\Phi_{solid} = 0.87$), which suggests that the 7-membered ring structure contributes to the AIE effect, but does not compensate the effect of long conjugated systems such as PPV.

![Figure 5](https://repository.kulib.kyoto-u.ac.jp/)

**Figure 5.** (a) UV absorption spectra of PST, BPST[5], BPST[6], and BPST[7] in THF (The concentration of each compound is $1.0 \times 10^{-5}$ M). (b) Fluorescence spectra of PST, BPST[5], BPST[6], and BPST[7] in THF (The concentration of each compound is $1.0 \times 10^{-5}$ M). Small peaks around 330 nm were assigned to Raman scattering.

**Table 2.** Photophysical properties of the stilbenes and bridged stilbenes used in this study in solution and in the solid state.

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<th>Entry</th>
<th>Number of benzene rings</th>
<th>$\epsilon$ [M⁻¹ cm⁻¹]</th>
<th>$\lambda_{max}$ [nm]</th>
<th>$\lambda_{fl}$ (THF) [nm]</th>
<th>$\lambda_{fl}$ (solid)* [nm]</th>
<th>$\Phi_{fl}$ (THF)</th>
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<td>350</td>
<td>382</td>
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* polycrystalline solids. $^*$ BST[7] is a liquid at room temperature.
The single-crystal x-ray structure of BPST[7] is shown in Figure 6. As the adjacent π-planes of molecules of BPST[7] do not adopt a face-to-face conformation, these do not resemble H-type aggregates. On the other hand, the excitation spectrum of BPST[7] in the crystal is red-shifted compared to the absorption spectrum of BPST[7] in solution (Figure S48). Considering the maximum wavelengths of absorption and fluorescence in solution and the polycrystalline solid, the effect of excitonic coupling or excimer formation could be one possible explanation for the observed phenomenon. The details of the photophysical process of polycrystalline BPST[7] will be investigated in the future.

Both radiative and non-radiative decay processes can be observed in BDPST[7]. Picosecond laser-induced transient absorption measurements were carried out with a sub-nanosecond transient-absorption spectroscopy system based on the randomly interleaved pulse train (RIPT) method. After photoradiation, the S1 state (S1-S0, transient absorption: 720 nm) is generated, followed by fluorescence decay and the generation of an intermediate that follows the non-radiative decay pathway (420 nm) (Figure S49). The observed fluorescence lifetime was 0.17 ns. The lifetimes for the decay (0.21 ns) and the formation of the intermediate (0.24 ns) are approximately identical (Figure S50). Based on these results, it can be concluded that a structural change occurred due to internal conversion, as predicted by our calculations.

Fluorescence quantum yield of BST[n] and BPST[n]
In this section we will compare the experimental photophysical properties of the stilbenes and bridged stilbenes with their calculated values and respective PESs.

We first examined the ST and BST[n] series. The calculated order of the MECIs, BST[5] > BST[6] > BST[7], successfully predicted the fluorescence Φfl observed in solution. Every member of the series BST[n] shows enhancement of the Φfl in the solid state. As shown in Figure 3, the twisted-pyramidal CI accompanies a large movement of the phenyl groups. Suppression of this large motion in the aggregate form causes AIE or AIEE.

Subsequently, we examined the PST and BPST[n] series. The calculated order of the MECIs, BPST[5] > BPST[6] > BPST[7], corresponds to the order of the Φfl observed in solution. However, different from the ST/BST[n] series, PST and BPST[6] are emissive in solution. To understand the difference between the ST/BST[n] series and the PST/BPST[n] series, we compared the energy diagrams shown in Figure 2. Since the internal conversion, as predicted by our calculations.

## Table 3
<table>
<thead>
<tr>
<th>ST</th>
<th>PST</th>
</tr>
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<tbody>
<tr>
<td>ST[5]</td>
<td>+48.15</td>
</tr>
<tr>
<td>BST[6]</td>
<td>+0.84</td>
</tr>
<tr>
<td>BST[7]</td>
<td>-57.69</td>
</tr>
</tbody>
</table>
yields of this series of molecules. The calculated results suggest that BST[5] has a high fluorescence quantum yield ($\Phi_f$) and that BST[7] has a low $\Phi_f$. We then synthesized the BST[n] (5-7) and the BPST[n] (5-8) and compared the experimentally obtained results with the calculated predictions. Different luminescent properties such as aggregation-induced emission (AIE), aggregation-induced emission enhancement (AIEE), and aggregation-caused quenching (ACQ) were observed, depending on the structure of the stilbene. BST[7] showed excellent AIE properties ($\Phi_{col} = 0.02$, $\Phi_{sol} = 0.75$). Experimental $\Phi_f$ were rationalized qualitatively based on the predicted energy difference between the Franck-Condon (FC) state and the minimum energy conical intersection (MECI). We discovered that the length of the alkyl chain serves two important roles: a) mechanical control of the Cl and b) controlling the FC via distortion of the $\pi$-conjugation plane. These two effects are synergistic, and thus shorter alkyl chains increase the $\Phi_f$. These two effects are conjugation of the system lowers the FC and the local minimum energy conical intersection (MECI). We discovered that the overall photophysical properties of the stilbenes and the bridged stilbenes. Based on the theoretical predictions, we succeeded in designing and synthesizing new AIEgens. We are currently designing new dyes using this strategy and investigating the use of bridged stilbenes in applications such as sensors, liquid crystals, and supramolecular chemistry.

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Keywords: aggregation induced emission (AIE) • stilbene • environmental responsive non-radiative decay • control of conical intersection accessibility (CCIA) • potential energy surface (PES)


RESEARCH ARTICLE

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Entry for the Table of Contents

Bridged-stilbene: Based on theoretical prediction of non-radiative decay, a new family of aggregation-induced emission (AIE) luminogens is reported. Depending on alkyl chain length, they exhibit different quantum yields. BPST[7] and DPB[7] with excellent AIE behavior are reported.