All-organic Photomagnetic Switching

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Digital data storage relies on the change of a material's electrical, magnetic, or optical properties between two states, indicating 1 and 0. Smaller units of information storage are an interesting research target, because they could lead to higher-density storage. Molecular organic switches are interesting in this context.[1] However, the switching of spin states in all-organic molecules is challenging.

This contribution will focus on a helical photochemical spin-state switch.[2] Configurationally stable dimethyl[5]helicenes were used in the design of a photochemical magnetic switch with bistable spin states (Figure 1).[2] When introducing quinoidal 4,11-substituents, such as oxo or dicyanomethylidene, the helicene undergoes rapid electrocyclization which can be reversed using light as stimulus (77 K). Upon photochemical ring opening at cryogenic temperatures, the helicene favours a diradical configuration with a triplet ground state and a stable EPR signal. The process is fully reversible under thermal conditions and heating (to 93 K for R = C(CN)2 or 127 K for R = O) recovers the diamagnetic closed-shell form via electrocylization. The system can be cycled without any significant degradation and represents a bistable photomagnetic switch that operates under chemical reactivity.

Our current developments indicate that such photomagnetic switching can be highly tuned to different temperature profiles, reaching up to room temperature.

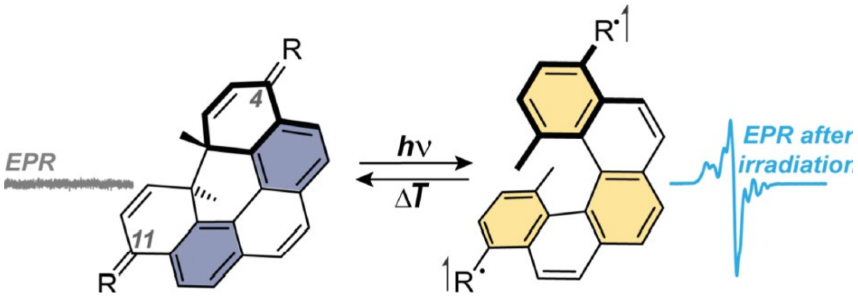

Figure 1. Dimethyl[5]helicene with various 4,11-substituents (R) for photochemical spin-state switching.

References

[1] For a full journal issue on molecular spintronics and quantum computing, see: E. Coronado, A. J. Epsetin, J. Mater. Chem. 2009, 19, 1670.

[2] K. Günther, N. Grabicki, B. Battistella, L. Grubert, O. Dumele, *J. Am. Chem. Soc.* **2022**, *144*, 8707.