New molecular switches for CO_2 capture controlled by light

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In the last years, carbon dioxide concentration in the atmosphere is reaching alarmingly high levels, which human activity is the main responsible for.[1] Power stations account for most of the CO_2 emissions, which can be reduced by means of carbon dioxide capture technologies (CCS).[2] However, traditional CCS techniques such as amine scrubbing require a high energy consumption in order to recover the CO_2 absorbing materials.[2] To reduce this toll, more sustainable CCS technologies have to be developed, such as those based on photorecyclable absorbent materials.[3] In this work we explore a new strategy to obtain light-controlled CO_2 capture that relies on the use of photoinduced molecular switches, whose interaction with carbon dioxide changes on photoisomerization between their two states. In particular, attention has been focused on spiropyran and spirothiopyran switches,[4] which photoisomerize between (i) an inert spiranic state (Spir), and (ii) a merocyanine isomer (MC) that presents (thio)phenolate groups capable of interacting with CO_2. To explore this concept, light-controlled carbon dioxide capture has been tested for several spirothiopyran and spiropyran analogues through two different mechanisms: (i) the direct interaction of the (thio)phenolate moieties with CO_2 in anhydrous polar solvents, and (ii) the indirect CO_2 capture through acid-base reaction with carbonic acid in aqueous media. The molecular switches with the most promising results have also been introduced in solid materials based on hydrogels to produce a material capable of capturing CO_2 and releasing it upon irradiation.

References

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