LIGATION OF OLIGONUCLEOTIDES INDUCED BY CHARGE-TRANSFER INTERACTIONS

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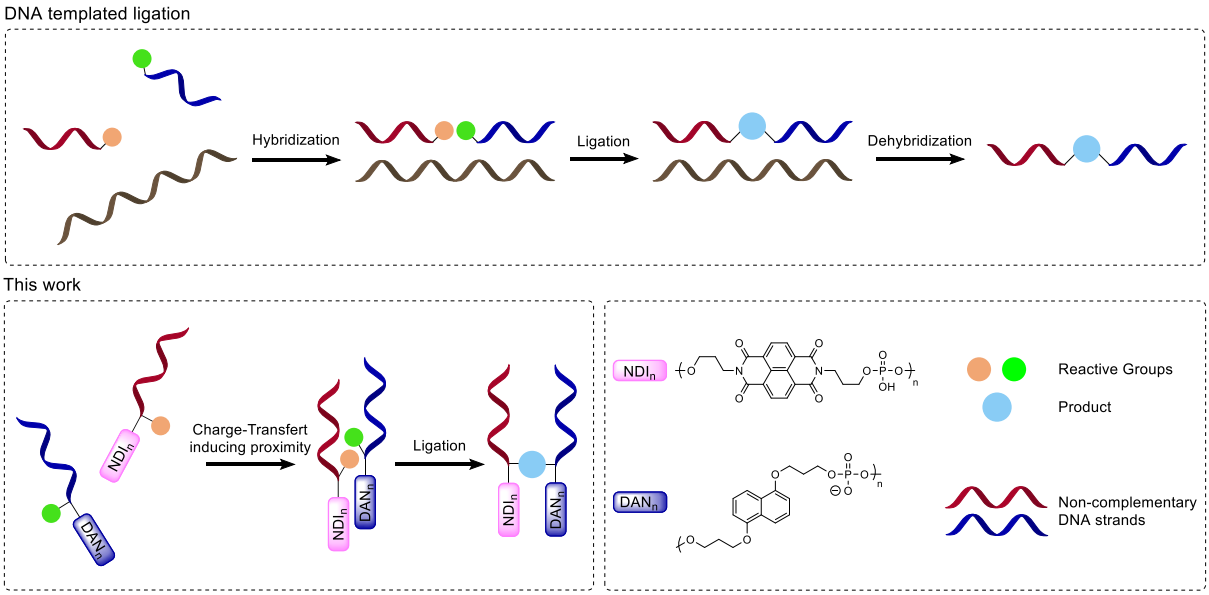
Intermolecular interactions, like hydrogen bonding or Van-Der-Waals forces, are ubiquitous in chemistry guiding both natural (DNA, proteins) and synthetic supramolecular assemblies. Among these interactions, charge transfer (CT) interactions received a particular attention due to the wide range of potential applications.[1] Charge transfer can be defined as the electrostatic attraction between an electron-rich entity, the donor (D), and an electron-poor unit, the acceptor (A). This attraction allowed an alternative stacking between these two species that can lead to strong supramolecular assemblies called CT-complexes.[2] Among the various D and A pairs that have been identified, the most popular pair for forming CT complexes is naphthalene diimide (NDI) and dialkoxynaphtalene (DAN).[3]
In this context, DAN/NDI interactions can be used to induce proximity effect between two biomolecules, such as oligonucleotides strands.[4] Usually, the ligation of two oligonucleotides carrying reactive functions proceed through the use of a third strand, acting as a template to bring the reactive groups in close proximity.[5] In this project, we propose to use the charge transfer interaction to enhance the effective molarity of two non-complementary DNA strands in diluted media.
We achieved this by synthesizing DAN and NDI phosphoramidite building blocks,[6] which were introduced into DNA sequences. With this method, we developed an innovative and universal ligation approach that proceeds at submicromolar concentrations and in mild aqueous conditions.



References

[1] Das, A., Ghosh, S., *Angew. Chem. Int. Ed.* **2014**, *53*, 2038–2054.
[2] Bender, C. J., *Chem. Soc. Rev.* **1986**, *15*, 475–502.
[3] Ikkanda, B. A., Iverson, B. L., *Chem. Commun.* **2016**, *52*, 7752–7759.
[4] Pérez de Carvasal, K., Riccardi, C., Russo Krauss, I., Cavasso, D., Vasseur, J.-J., Smietana, M., Morvan, F., Montesarchio, D., *Int. J. Mol. Sci.* **2021**, *22*, 9510.
[5] Di Pisa, M., Seitz, O., *ChemMedChem* **2017**, *12*, 872–882.
[6] Carvasal, K. P. de, Aissaoui, N., Vergoten, G., Bellot, G., Vasseur, J.-J., Smietana, M., Morvan, F., *Chem. Commun.* **2021**, *57*, 4130–4133.