Evolution in Polymer Technology Journal

Chembio Publishers
Right Choice for Researchers

Editorial

Volume 2; Issue 2

# Dual (Fluoride and Cyanide) Anion Recognition *via* BODIPY Receptors

**Masood Ayoub Kaloo***

Department of Chemistry, Government of Degree College Shopian, India

***Corresponding author**: Dr. Masood Ayoub Kaloo, Assistant Professor, Labortory of Molecular Materials, Supramolecular, Analytical and Environmental Chemistry, Department of Chemistry, GDC Shopian Kmr-192303, India, Tel no: +91-8491857406; Email: makandchem@gmail.com

**Received Date:** April 08, 2019; **Published Date:** April 18, 2019

## Abstract

Diverse means of interactions for dual anion recognition is pretty fascinating area of research. From last few decades, polarized free amine fragments, bond breakage, and related approaches have been tried to achieve the dual anion recognition and discrimination of fluoride ($F^-$) and cyanide ($CN^-$). In this regard, signaling unit in the form of BODIPY dye has been regularly brought in for the purpose. This is attributed to the fascinating fluorescent properties of the fluorophore. In this work, I will be focusing on the basic aspects of the reports besides mechanism of interaction.

**Keywords:** Polymerization; Emulsion; Micelles

## Introduction

Among the various anions, $F^-$ and $CN^-$ occupy an important place in the field of anion recognition, owing to their fundamental role in chemistry, catalysis, environment and biology [1-3]. Thus, considerable attention has been paid by the research community to develop a library of single-molecule based receptors for these analytes [4-6]. From the literature survey, it clear that both the anions exhibit similar binding behaviour with urea or amide based scaffolds [7-9]. The $F^-$ and $CN^-$ recognition has usually been achieved by hydrogen-bonding or deprotonating through excited state intra or intermolecular proton transfer mechanism [10,11]. Even though certain reaction-based approaches in the form of distillation for fluoride and nucleophile substitution for cyanide have been introduced [12-18], but single molecular systems providing naked-eye recognition of both fluoride and cyanide anion is very rare. Further, detection of $F^-$ and $CN^-$ is reported either by colorimetric or fluorimetric signalling response. Therefore, it has always been a challenge to develop novel approaches for their dual-modal recognition. Further, there are only a handful of reports available wherein both recognition as well as discrimination of $F^-$ and $CN^-$ was accomplished.

## Literature Overview

Structural robustness and strong fluorescence quantum yield of BODIPY dye has been the reason for its extensive use in molecular recognition studies for various environmental and biological applications [19]. Many such attempts have been carried out for $F^-$ and $CN^-$ recognition. Among the existing reports, Akkaya *et al*. reported monostyryl-boradiazaindacene BODIPY for selective sensing of $CN^-$. Presence of a trifluoroacetyl group in the compound, impart exclusive selectivity towards the cyanide anion [20]. The authors further reported dual anion recognition of $F^-$ and $CN^-$ via tethering difluoro Boron Bridge in to the BODIPY [21]. The presence of $F^-$

**Citation**: Masood Ayoub Kaloo. Dual (Fluoride and Cyanide) Anion Recognition via BODIPY Receptors. Evolution Poly Tech J 2019, 2(2): 180011.

and $CN^-$ dislodges difluoro boron bridge during their interaction with the receptor and results in the modulation of the photo physical behaviour of the compound.

Ravikanth *et al*. achieved selective detection of cyanide by direct incorporation of formyl group into the BODIPY [22]. Formation of cyanohydrin via attack of $CN^-$ on the formyl group was reported with both visible fluorescence as well as chromogenic changes during recognition events. Similar type of results was also revealed with *meso*-salicylaldehyde substituted BODIPY [23]. Same group further reported selective fluoride recognition by benzimidazole substituted boron-dipyrromethene [24]. The existence of intramolecular hydrogen bonding between hydrogen atom (N-H) of benzimidazole and fluorine atoms of $BF_2$ in BODIPY polarizes the –N-H bond, sufficient enough to under anion recognition. The presence of $F^-$ in the receptor solution promotes blockade of electronic communication between imidazole and BODIPY via the disruption of intramolecular hydrogen bonding between them. The corresponding events were visually marked with colour and fluorescence output.

In addition to these reports, Thilagar *et al*. presented $F^-$ recognition from dimesitylboryl appended BODIPY. The recognition events were via a dual-emission response [24]. They further reported tricolour emission based response for selective $F^-$recognition with borane-bithiophene-BODIPY triad [26]. The recognition was visually signalled through colorimetric changes in the receptor solution.

## Conclusion

Highly sensitive and selective fluoride and cyanide recognition, along with their discrimination has been achieved so far through BODIPY based molecular receptor framework. The fluorophore framework has been structurally tuned to bring in such dual anion sensing events. We believe besides structurally modulation, solvent tuning might offer another useful platform to achieve the similar. In addition, there is a need to explore and develop new molecular systems which might decipher dual-channel visual display (colorimetric and fluorogenic) for each recognition event. Most importantly, dual-anion sensing under aqueous conditions need attention.

## Acknowledgement

M.A Kaloois highly thankful to the Head of the institute (Dr. Ali Mohammad Dar) for providing infrastructure and kind support throughout this work. M. A. Kaloo gratefully acknowledges Department of Science and Technology, New Delhi for INSPIRE-FACULTY research grant [DST/INSPIRE/04/2016/000098].

## References

1. Zhou Y, Xu Z, Yoon J (2011) Fluorescent and colorimetric chemosensors for detection of nucleotides, FAD and NADH: highlighted research during 2004-2010. J Chem Soc Rev 40(5): 2222-2235.

2. Zhang JF, Zhou Y, Kim JS, Yoon J (2011) Recent progress in fluorescent and colorimetric chemosensors for the detection of precious metal ions (silver, gold and platinum ions). Chem Soc Rev 40(7): 3416-3429.

3. Zhou Y, Yoon J (2012) Recent progress in fluorescent and colorimetric chemosensors for the detection of amino acids. Chem Soc Rev 41(1): 52-67.

4. Yen YC, Cheng CC, Tsai JY, Lin IH, Yang YS, et al. (2012) Molecular recognition within a poly (amide urethane) system. Polymer 53(18): 3951-3957.

5. Gale PA (2001) Anion receptor chemistry: highlights 1999. Coordination Chemistry Review Coord. Chem Rev 213(1): 79-128.

6. Sheshanath VB, Chintan HJ, Steven JL (2008) Chemistry of naphthalene diimides. Chem Soc Rev 37(2) 331-342.

7. Kumar GR, Thilagar P (2014) Dicyanovinyl substituted triarylboranes: a rational approach to distinguish fluoride and cyanide ions. Dalton Trans 43(19): 7200-7207.

8. Guliyev R, Ozturk S, Sahin E, Akkaya EU (2012) Expanded bodipy dyes: Anion Sensing Using a Bodipy Analog with an additional Difluoroboron bridge. Org Lett 14 (6): 1528-1531.

9. Mahapatra AK, Manna SK, Pramanik B, Maiti K, Mondal, et al. (2015). Colorimetric and ratiometric fluorescdent chemodosimeter for selective sensing of fluoride and cyanide ions: tunning selectivity in proton transfer and C-SI bond cleavage. RSC Adv 5(14): 10716-10722.

10. Jose DA, Kumar DK, Ganguly B, Das A (2004) Efficient and Simple Colorimetric Fluoride Ion Sensor Based on Receptors Having Urea and Thiourea binding sites. Org Lett 6(20): 3445-3448.

11. Cristopher BB, Bruno A, Andrew CT, Cristina R, Jonathan LS, et al. (1999). Dipyrrolylquinoxalines: Efficient Sensor for Fluoride Anion in Organic Solution. J Am Chem Soc 121(44): 10438-10439.

12. Jo M, Lim J, Miljanic OS (2013). Selective and sensitive Fluoride Detection through Alkyne Cruciform Desilylation. Org Lett 15(14): 3518-3521.

13. Cho DG, Kim JH, Sessler JL (2008). The benzyl-cyanide reaction and its application to the development of a selective cyanide anion indicator. J Am Chem Soc 130(36): 12163-12167.

14. Swamy PC, Mukherjee S, Thilagar P (2014). Dual Binding Site Assisted Chromomeric and Fluorogenic Recognition and Discrimination of Fluoride and Cyanide by a Peripherally Borylated Metalloporphyrin: Overcoming Anion Interference in Organoboron Based Sensors. Anal Chem 86(7): 3616-3624.

15. Ramalingam, M.; Angupillai, S.; Kupponagounder, P. E. New. J. Chem. 2013, 37, 3152.

16. Sharma S, Hundal MS, Hundal G (2013) Dual channel chromo/fluorogenic chemosensors for cyanide and fluoride ions-an example of in situ acid catalysis of the strecker reaction for cyanide ion chemodosimetry. Org Biomol Chem 11(4): 654-661.

17. Seifert S, Schmidt D, Würthner F (2015) An ambient stable core-substituted perylene bisimide dianion: isolation and single crystal structure analysis. Chem Sci 6(3): 1663-1667.

18. Frank W (2004) Perylene bisimide dyes as versatile building blocks for functional supramolecular architectures. Chem Commun (Camb) 14: 1564-1579.

19. Cho DW, Fujitsuka M, Ryu JH, Lee MH, Kim HKI, et al. (2012). S2 emission from chemically modified BODIPYS. Chem Commun 48(28): 3424-3426.

20. Ekmekci Z, Yilmaz MD, Akkaya EU (2008) A Monostyryl-boradiazaindance (BODIPY) Derivative as Colorimetric and Fluorescent Probe for Cyanide ions. Org Lett 10(3): 461-464.

21. Guliyev R, Ozturk S, Sahin E, Akkaya EU (2012) Expanded bodipy dyes: anion sensing using a bodipy analog with an additional difluoroboron bridge. Org Lett 14(6): 1528-1531.

22. Madhu S, Basu SK, Jadhav S, Ravikanth M (2013) 3,5-Diformyl-borondipyrromethene for selective detection of cyanide anions. Analyst 138(1): 299-306.

23. Dvivedi A, Rajakannu P, Ravikanth M (2015). meso-Salicyaldehyde substituted BODIPY as a chemodosimetric sensor for cyanide ions. Dalton Trans 44(9): 4054-4062.

24. Madhu S, Ravikanth M (2014) Boron-Dipyrromethene Based Reversible and Reusable Selective Chemosensor for Fluoride Detection. Inorg Chem 53(3): 1646-1653.

25. Swamy CA, Mukherjee S, Thilagar P (2013) Dual emissive borane-BODIPY dyads: molecular conformation control over electronic properties and fluorescence response towards fluoride ions. Chem Commun (Camb) 49(10): 993-995.

26. Sarkar SK, Kumar GR, Thilagar P (2013) White light emissive molecular siblings. Chem Commun 52(22):4175-4178.