

# CARBON QUANTUM DOTS WITH HIGH QUANTUM YIELD AS EFFICIENT FLUORESCENT PROBE FOR NITRITE IONS SENSING IN MEAT

Carneiro, S.V.; Oliveira, J. J. P.; Fechine, L. M. U. D.; Antunes, R. A.; Neto, M. L. A.; Moura, T. A.; César, C.L.; Carvalho, H. F.; Paschoal, A. R.; Fechine, P.B.A., Melo, R.

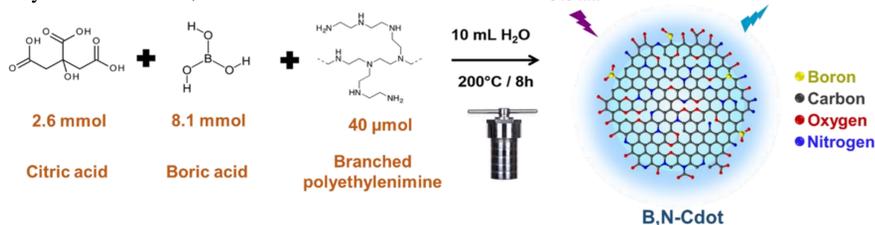
## Introduction

- Nitrite ion ( $\text{NO}_2^-$ ) is an inorganic compound usually present in drinking water and industrialized foods. As an additive, it is commonly used in meat products since reduces the growth of bacteria and ensures the conservation of meat color and flavor;
- In 2015, the International Agency for Research on Cancer (IARC) classified processed meats containing  $\text{NaNO}_2$  in formulation as **Group 1 carcinogens**.
- Therefore, it is extremely relevant to develop simple and effective methodologies to detect the concentration of  $\text{NO}_2^-$  ions.
- In this work, we proposed the boron and nitrogen doped-carbon quantum dots can be used to detect  $\text{NO}_2^-$  ions in meat. By testing our sensing platform in colloidal suspension, the recovery percentage was found to be up to 100.76% in a meat sample and a detection range concentration of 20 to 50  $\text{mmol L}^{-1}$ .

## Materials and Methods

- Citric acid ( $\text{C}_6\text{H}_8\text{O}_7$ , Vetec, 99.5%), boric acid ( $\text{H}_3\text{BO}_3$ , Dinamica, 99.5%) and branched polyethyleneimine (bPEI, Sigma-Aldrich, 25,000  $\text{g mol}^{-1}$ ) were used to prepare the CQDs. A cellulose membrane Spectra/Por®6 dialysis membrane of 1 kDa MWCO was used for dialysis.

- Synthesis of the B,N-Cdot



## Results and Discussion

### Characterization of the B,N-Cdots

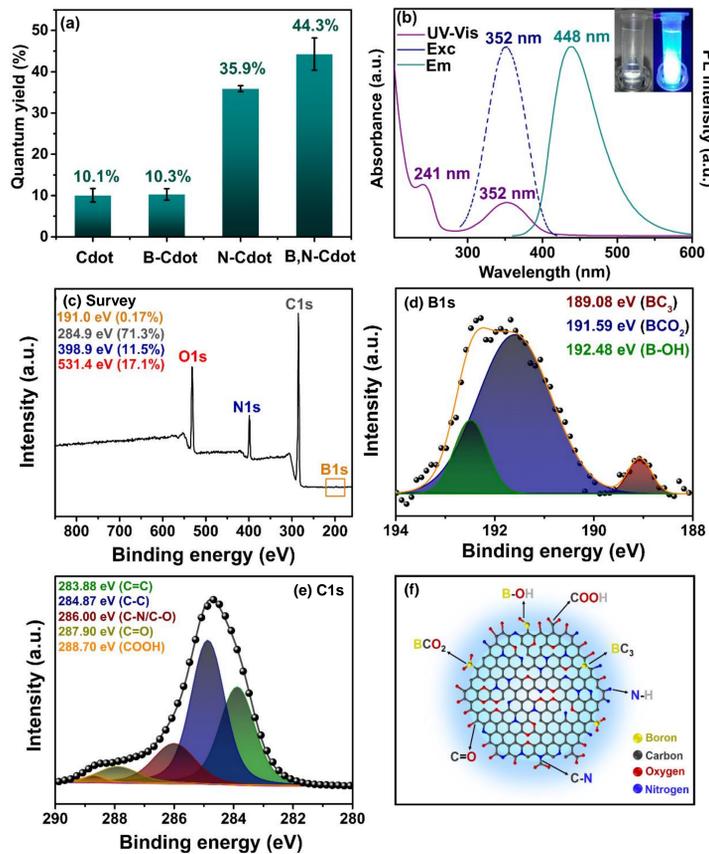
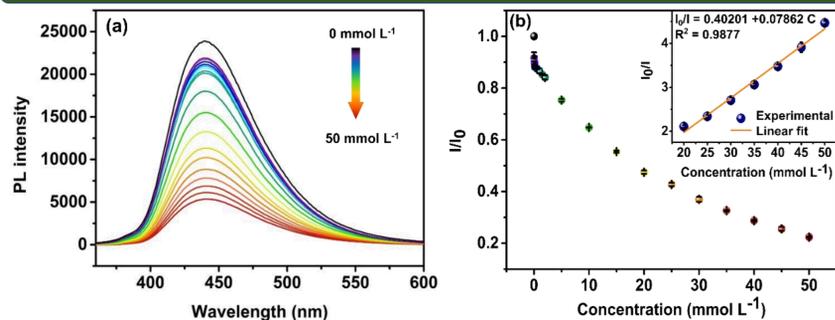


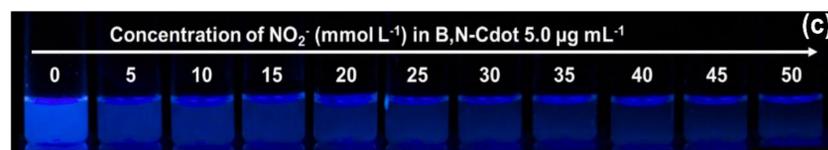
Figure 1. Results of spectroscopic characterizations: (a) Quantum Yield; (b) UV-Vis, excitation and emission spectra of B,N-Cdot. Also, XPS measurements (c) Survey, (d) B1s, (e) C1s and (f) Structure.

## Results and Discussion

### Sensing Experiments

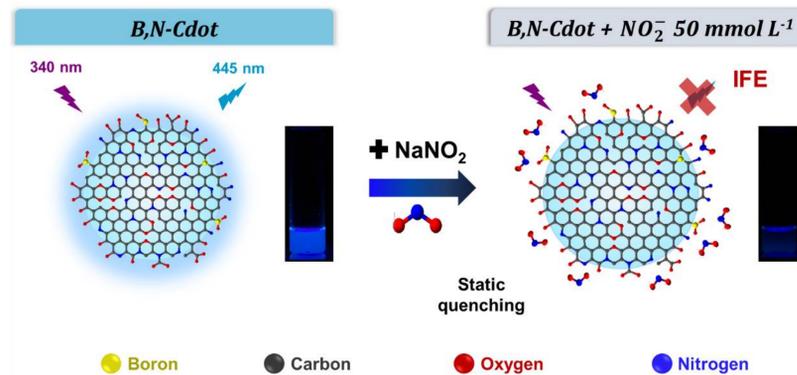


✓ Linear relationship between ion concentration and quenching



✓ Naked-eye detection

Figure 2. Titration curve of sample B,N-Cdot with different concentrations of  $\text{NO}_2^-$  ions at 298.65 K in PBS 7.4. (a) Concentration, (b) Normalized Fluorescence and (c) naked-eye detection.



✓ Detection mechanism

Figure 3. Quenching mechanism expected by the interaction of B,N-Cdots and  $\text{NO}_2^-$  ions.

Table 1. Determination of the  $\text{NO}_2^-$  concentration in meat samples using the proposed strategy.

Spiked ( $\text{mmol L}^{-1}$ )	Found ( $\text{mmol L}^{-1}$ )	Recovery (% n = 3)	RSD (n = 3)
50.0	48.76	97.52	0.49
40.0	41.56	103.90	0.90
30.0	27.43	91.43	0.16
20.0	20.15	100.76	0.57

✓ Recovery experiments in real samples

## Conclusion

- We have successfully reported a new  $\text{NO}_2^-$  ion sensing platform based on boron and nitrogen CQDs fluorescence quenching mechanism;
- The sensing strategy proved our B,N-Cdot could be applied in the determination of high concentrations of  $\text{NO}_2^-$  ions in meat samples with a recovery of 100.76% at the concentration of 20  $\text{mmol L}^{-1}$  of the analyte;
- Besides the results, more studies must be done in order to develop a sensing device to be used as a suitable alternative to conventional analysis methods.

## Acknowledgments

