

PFOS and PFOA Interaction with Organic Chromophore-Bound Serum Albumin

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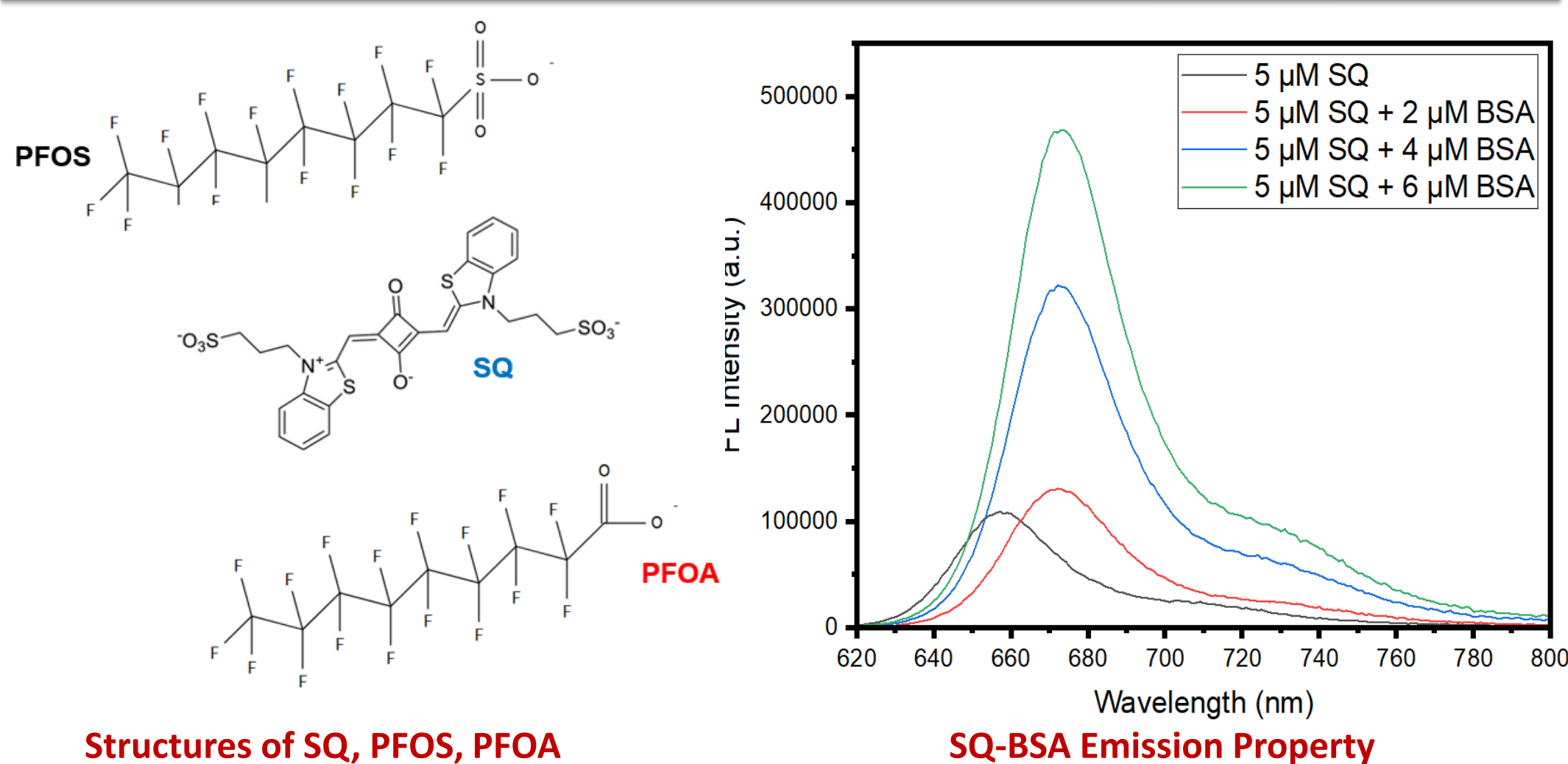
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INTRODUCTION & AIM

- ✓ Perfluorooctane sulfonate (PFOS) and perfluorooctanoic acid (PFOA) are persistent in water bodies and are highly thermal and chemical stable, making them non-biodegradable.
- ✓ Bovine serum albumin (BSA) has 583 amino acids and mostly α -helical structure. This protein can bind with many biomolecules as well as metal complexes, drug molecules, and organic dyes. When bound with proteins, this can pose health risks.
- ✓ As such, fluorescence spectroscopy is used to sense PFOS and PFOA using SQ-BSA complex. Squaraine (SQ) is a group of chromophores defined by their aromatic four-membered ring structure.
- ✓ In brief, the amphiphilic SQ dye forms low emissive aggregates in aqueous solution, but after the introducing of BSA, these SQ aggregates dissociate and becomes captured into BSA's hydrophobic cavities to generate BSA-SQ complex with strong fluorescence signal.
- ✓ Subsequent PFOS and PFOA addition revealed a gradual fluorescence turn-on and turn-off respectively, which continued to change along these two directions up to 20 μ M.
- ✓ Overall, these sequentially studied tri-component systems (SQ, BSA, PFOS/PFOA) discriminative detection relies on the SQ-BSA's different interacting behaviors with PFOS and PFOA, hence providing a complementary approach for detecting PFOS/PFOA in water.
- ✓ Therefore, the result demonstrated a potential discrimination ability of PFOS and PFOA by the SQ-BSA complex becomes ascribed by the different interacting abilities of these two harmful pollutants with BSA amongst various studies.
- ✓ **AIM:** Considering the difficulties associated with PFOS/PFOA selectivity, this developed fluorescent segregation complex (SQ-BSA) herein could play an essential role in the physiological studies considering the harmful effects of PFOS and PFOA in the blood systems.

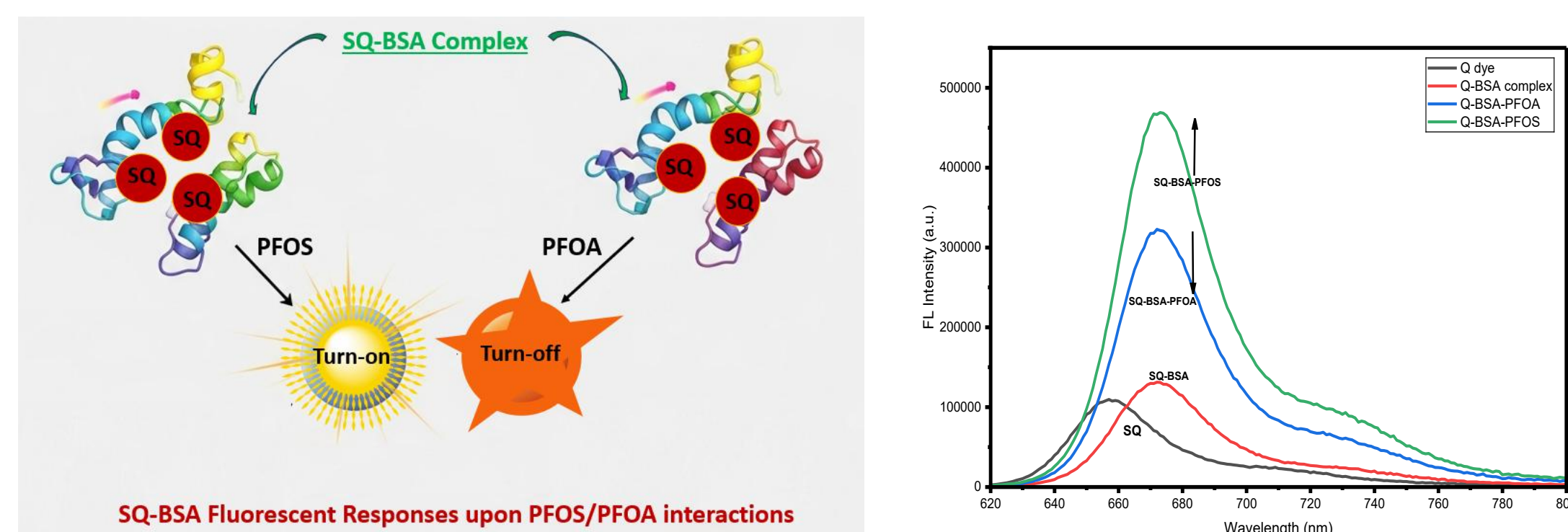
METHOD



Structures of SQ, PFOS, PFOA

SQ-BSA Emission Property

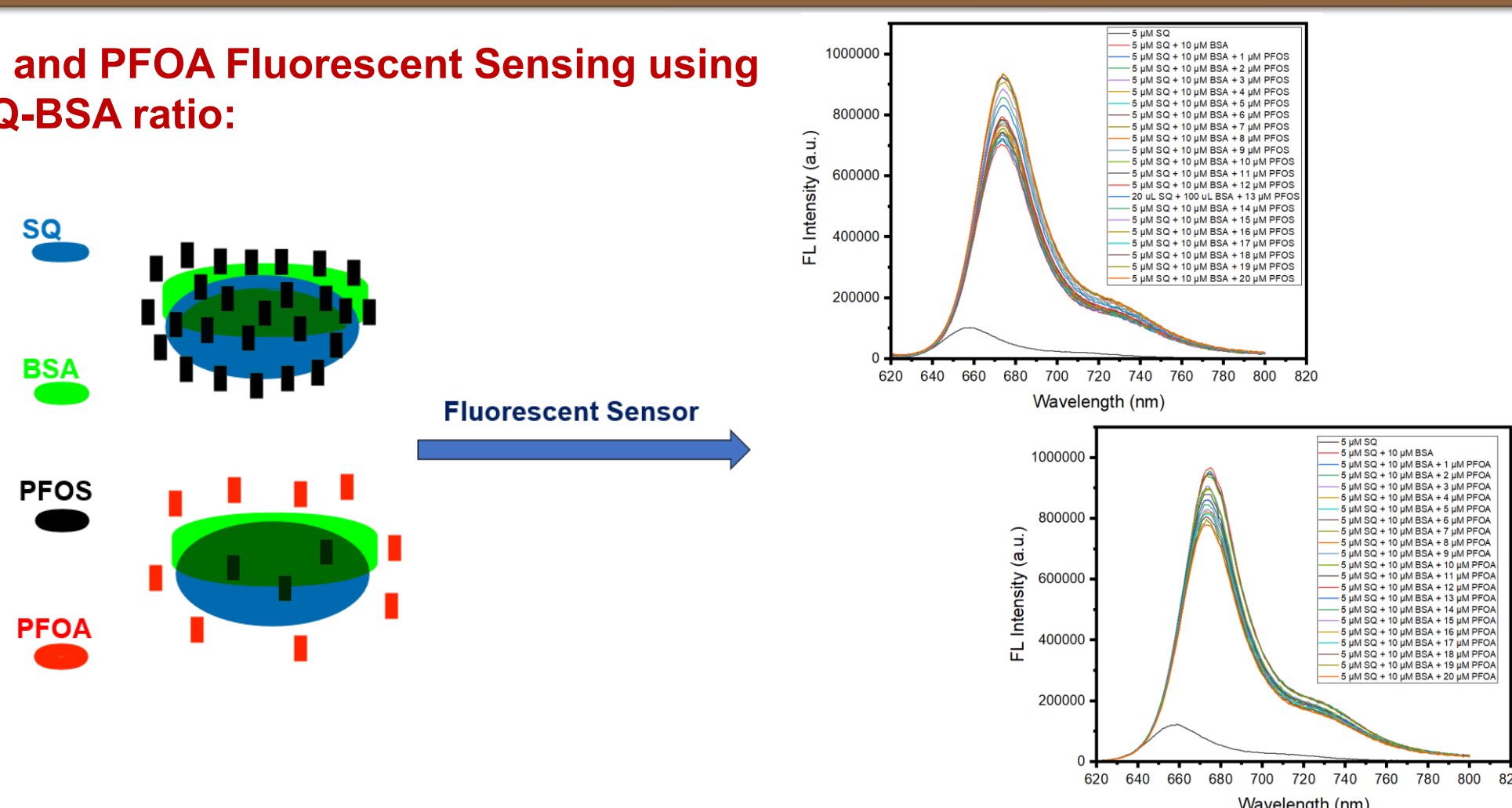
Fig. 1. Left, structures of SQ, PFOS and PFOA. Right, the emission spectra of SQ dye upon the introducing of BSA.



SQ-BSA Fluorescent Responses upon PFOS/PFOA interactions

RESULTS & DISCUSSION

PFOS and PFOA Fluorescent Sensing using 1:2 SQ-BSA ratio:



SQ-BSA Selective Response with PFOS/PFOA between (1 – 20) μ M concentrations.

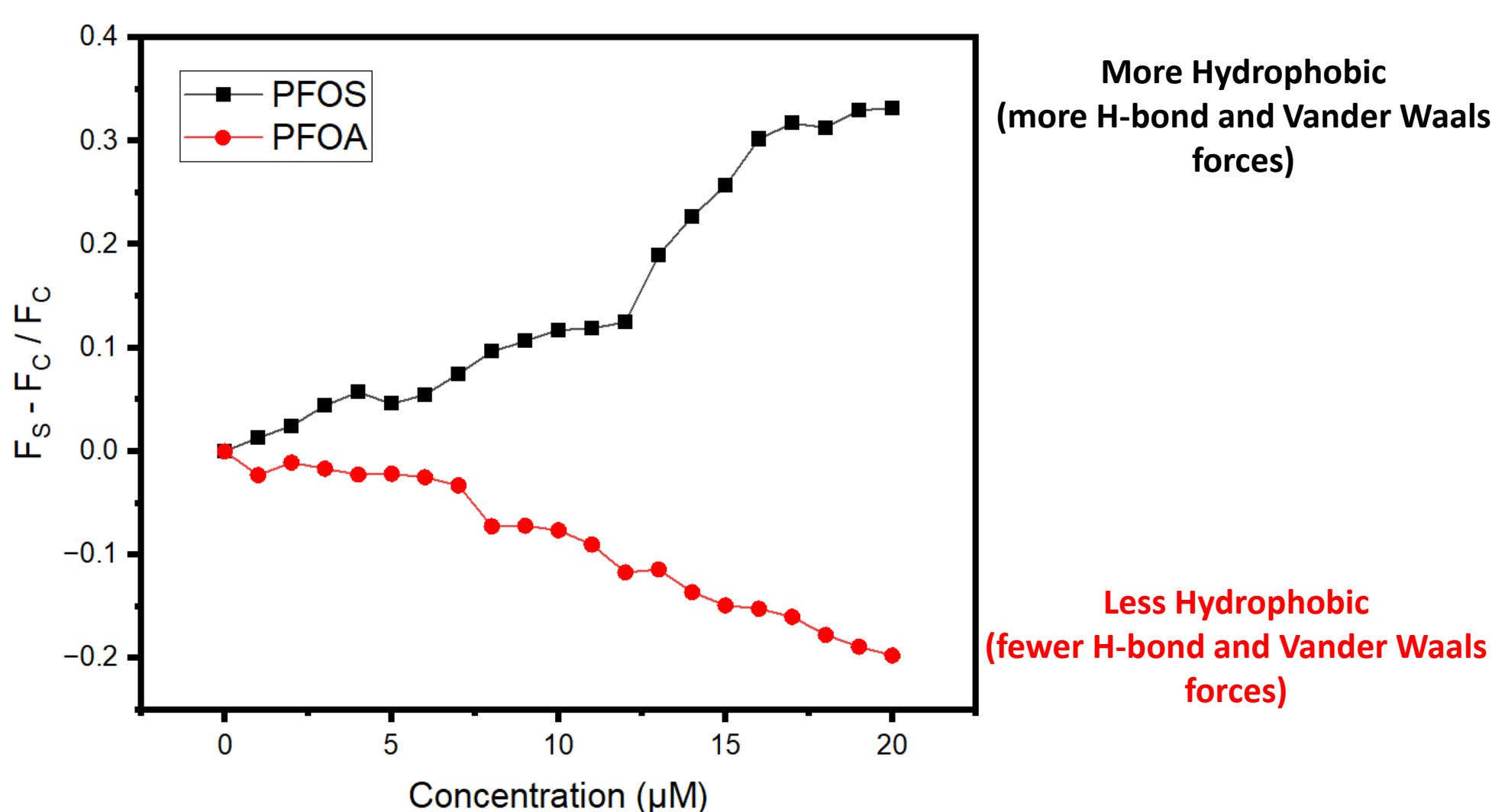


Fig. 2. The $(F_s - F_c) / F_c$ ratio for both PFOS and PFOA between (1 – 20) μ M concentrations under SQ-BSA complex (1:2) ratio independently.

Circular Dichroism Studies (CD): Revealing the BSA's secondary structural changes upon PFOS and PFOA interaction with SQ-BSA complex.

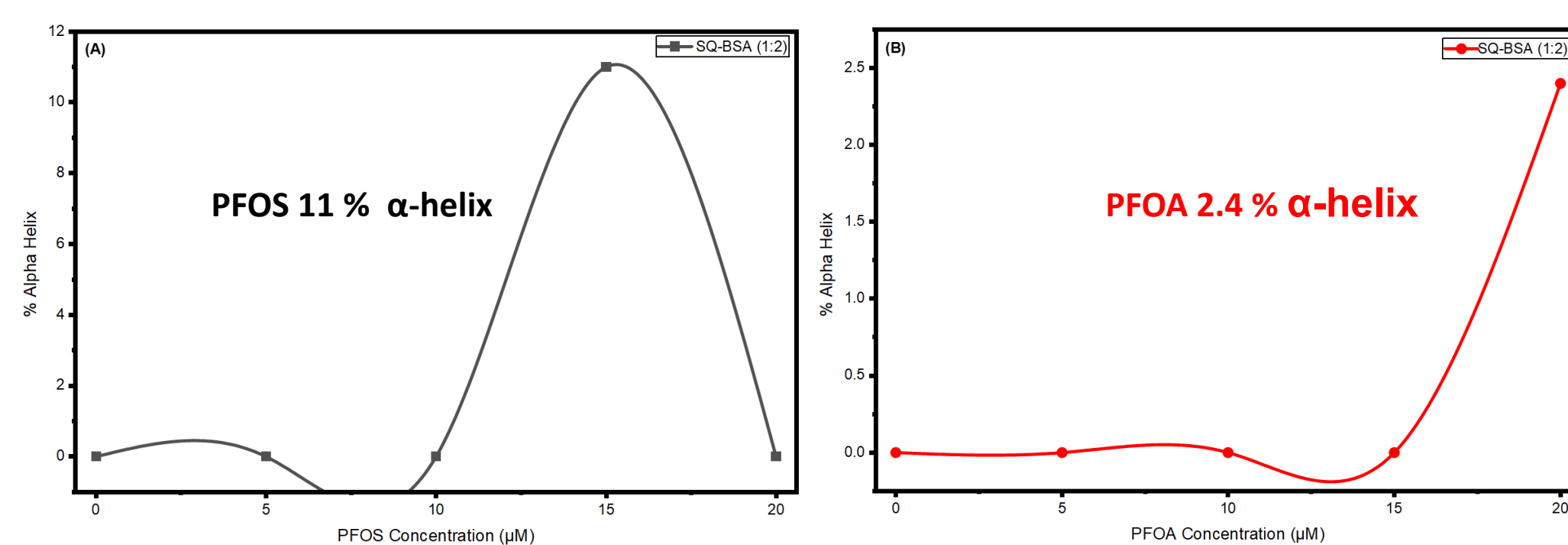


Fig. 3. Percentage α -helices using 1:2 ratios.

CONCLUSION

- ✓ SQ-BSA complex establishing a new concept which could be capable of discriminating these two essential PFAS derivatives of urgent concern basically by their distinct hydrogen bonds and van der Waals interactive forces.
- ✓ Demonstrates how PFOS/PFOA pollutants affect BSA through structural and photophysical evidence that shows how small chemical differences between PFOS and PFOA affect protein-pollutant binding.

FUTURE WORK / REFERENCES

- ✓ Provides specific methods for detecting PFOS and PFOA through optical means while revealing their binding mechanisms and denaturation processes.
 - ✓ Future studies needs to understand their impact on protein stability and transport in biological systems.
1. Zhang, Y., et al., *Bovine serum albumin nanoparticles with fluorogenic near-IR-emitting squaraine dyes*. ACS applied materials & interfaces, 2013. 5(17): p. 8710-8717.
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 3. Chen, H., et al., *Systematic investigation of the toxic mechanism of PFOA and PFOS on bovine serum albumin by spectroscopic and molecular modeling*. Chemosphere, 2015. 129: p. 217-224.