Enhanced Quantum Emitter Density in Hexagonal Boron Nitride via Organic Solvent Treatment

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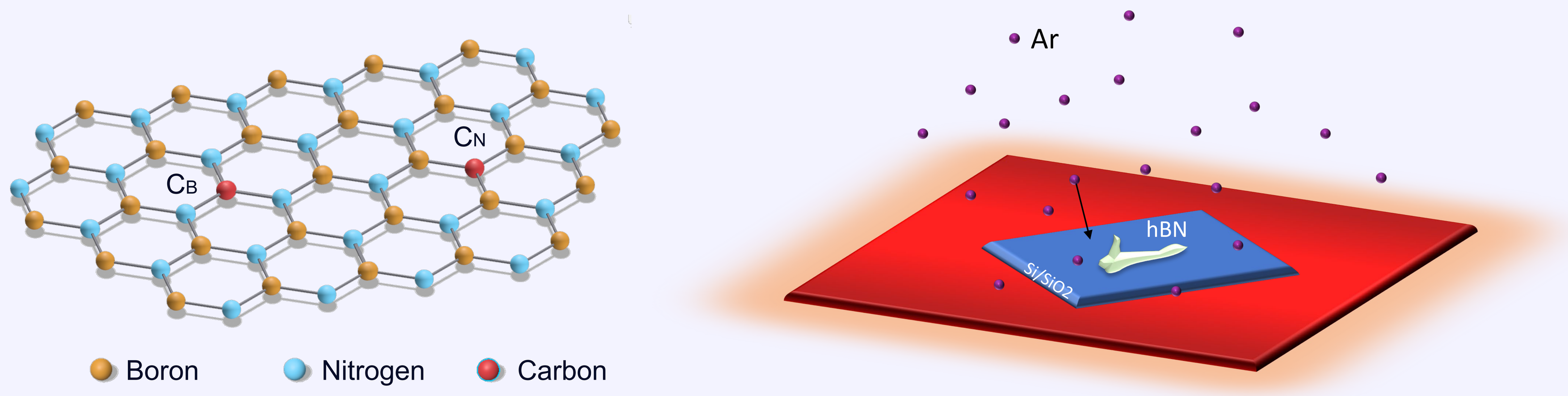
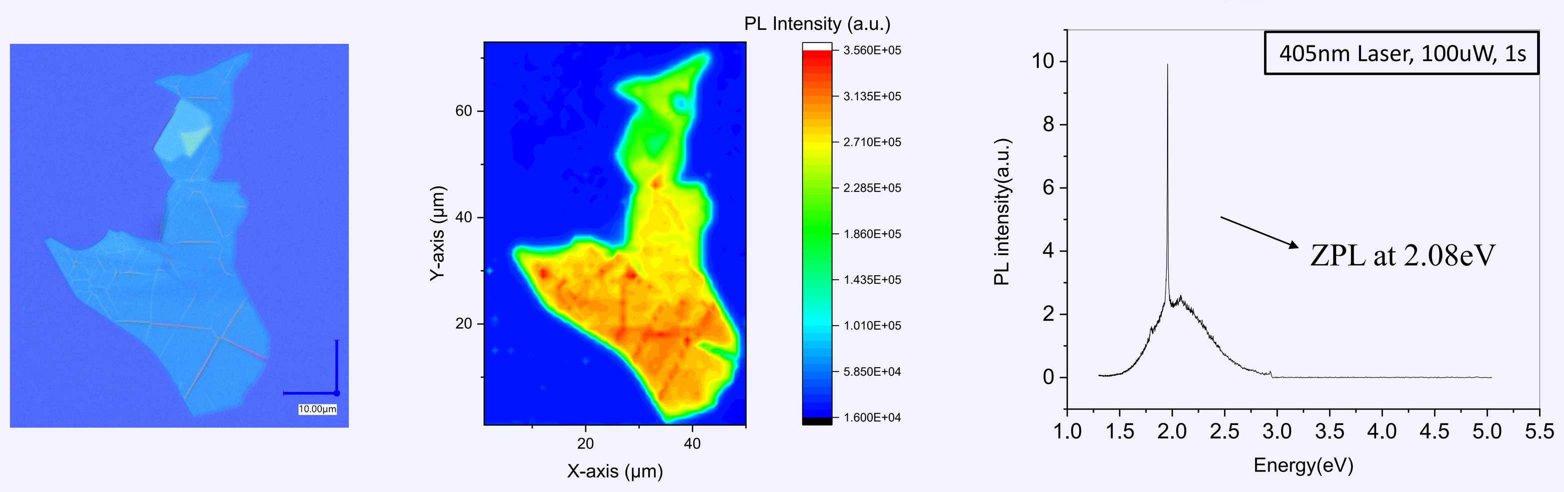
Abstract

Single-photon emitters (SPEs) are vital components for advanced quantum communication technologies. Hexagonal boron nitride (hBN), with its wide bandgap and van der Waals properties, presents a promising platform for room-temperature SPE operation. In this study, we substantially increase the density of quantum emitters in hBN by immersing the materiaes l in organic solvents, followed by thermal annealing in an argon (Ar) gas environment. This process not only enhances the yield of quantum emitters but also stabiliztheir emission properties, offering a robust and scalable method for producing ultrabright single-photon sources.

Argon Annealing

Anneal with 1 torr Argon gas at 850 ºC for 1hr

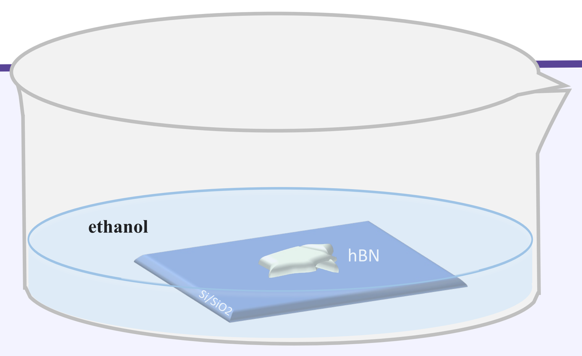


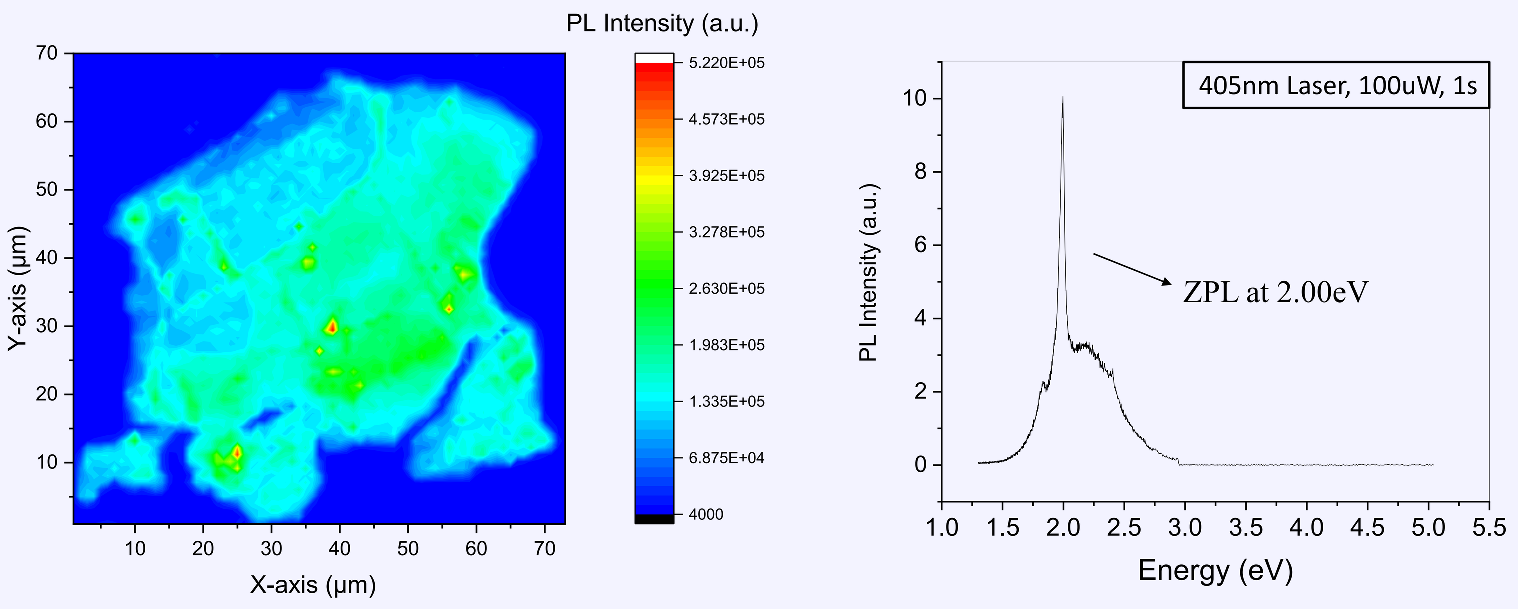


- Percent yield: 131 $\#/mm^2$, and its position are uncontrollable.
- The emission is Stable.

Chemical Solvent

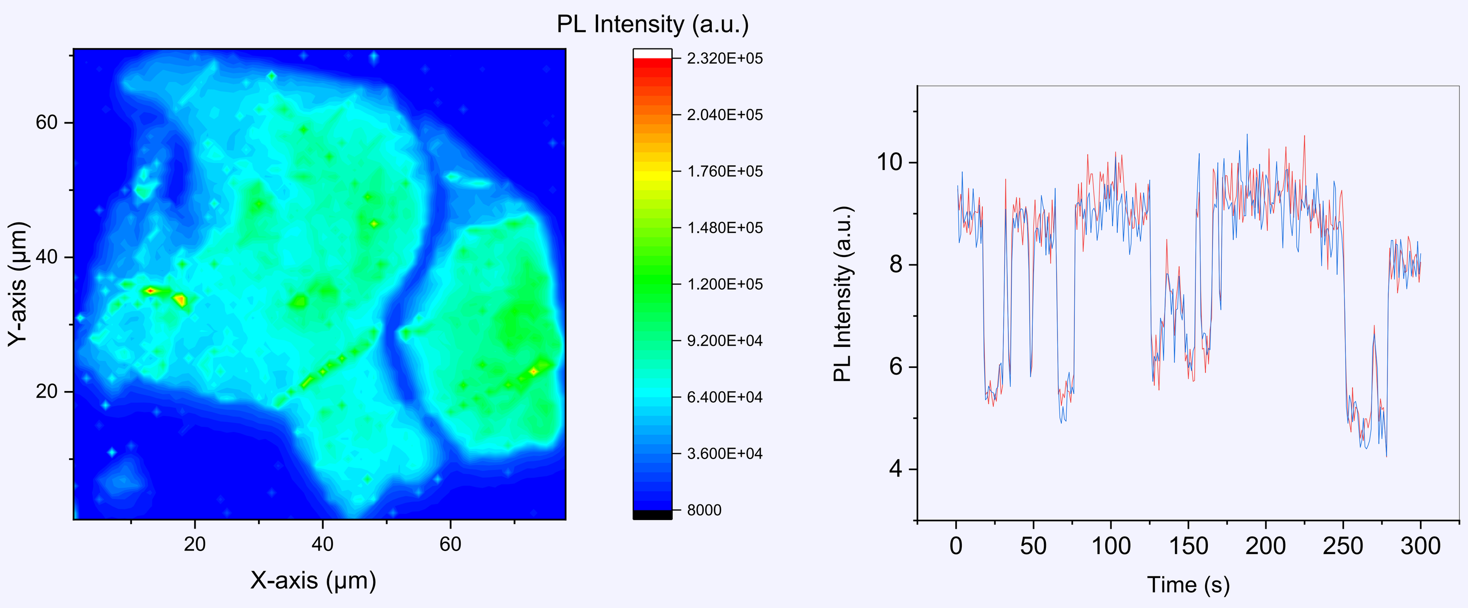
Soak hBN in ethanol for 10 minutes before Argon annealing for 1hr





- Percent yield: 1234 $\#/mm^2$
- Blinking

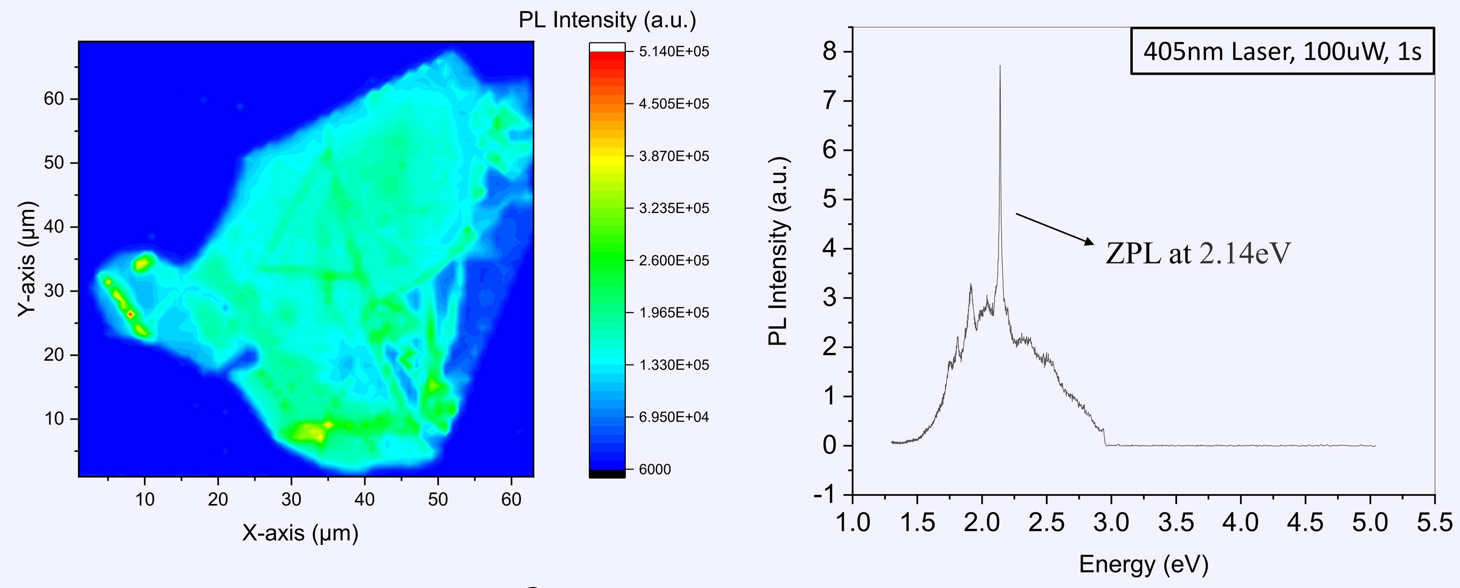
Argon annealing for 2hr



- Percent yield: 1429 $\#/mm^2$

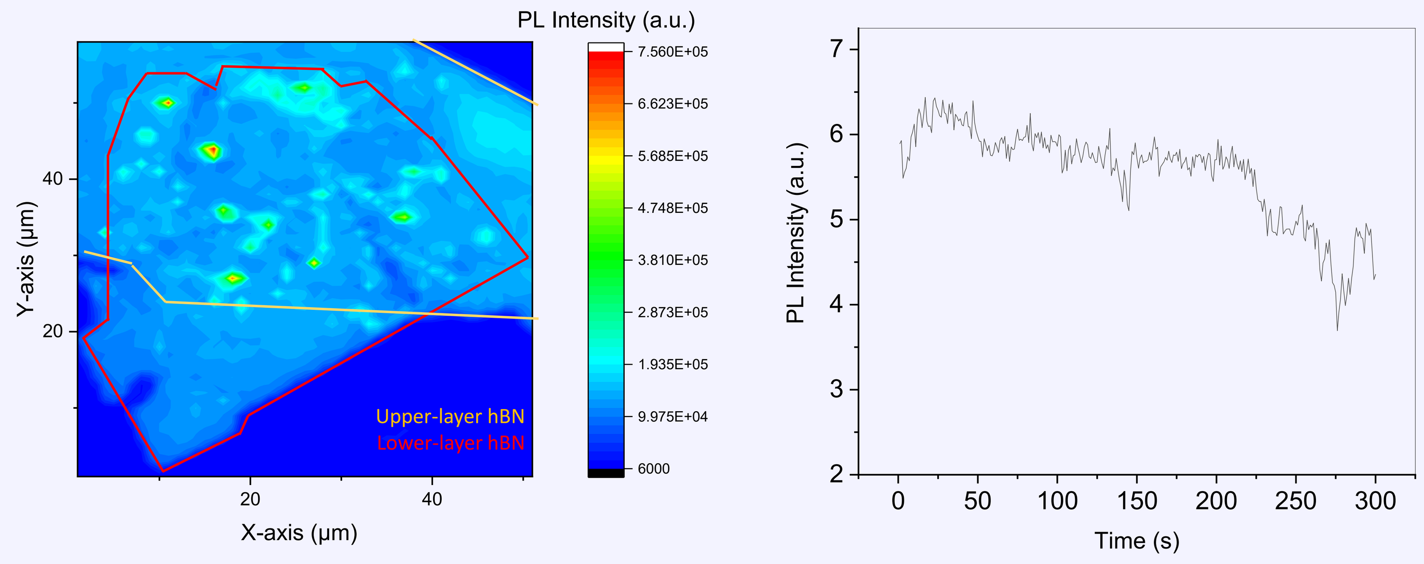
Capping with hBN

Anneal for 1hr then cap with hBN



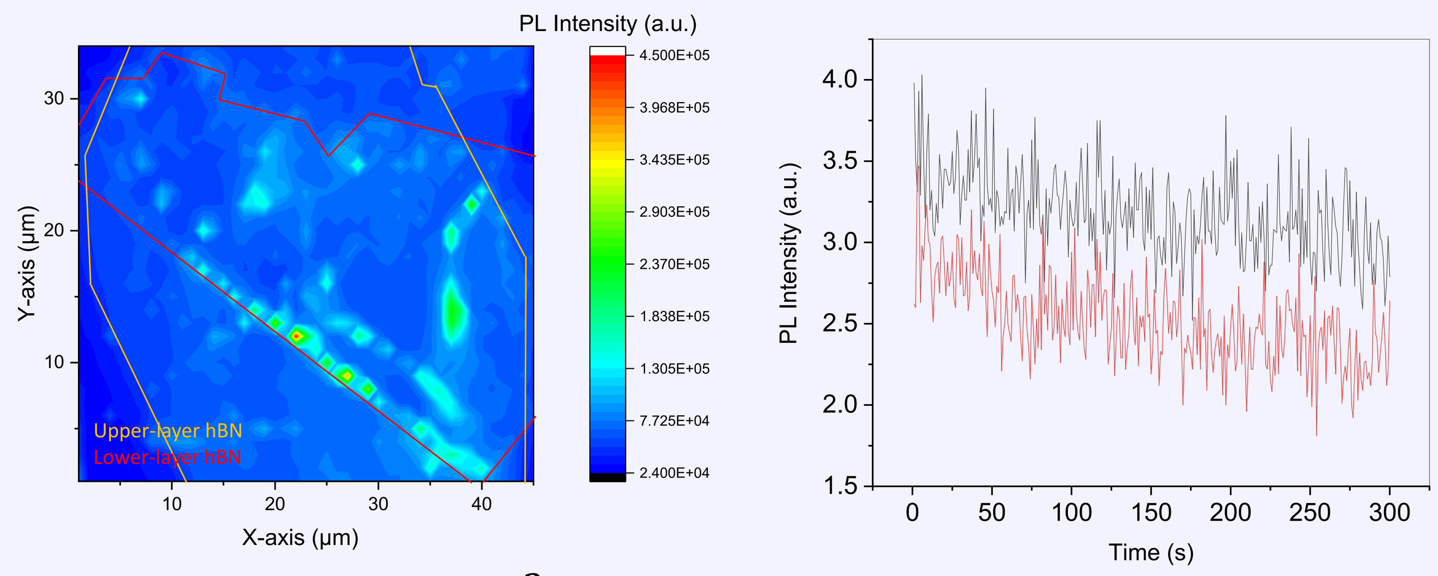
- Percent yield: 585 $\#/mm^2$
- Blinking

Cap with hBN before annealing for 1hr



- percent yield: 397 $\#/mm^2$
- Stable

Cap with hBN before annealing for 2hr



- Percent yield: 570 $\#/mm^2$

Conclusion

We explored methods for creating SPEs. Argon annealing can produce random emitters, while chemical treatments can increase yield but may lead to blinking.

1. By covering the surface of the emitters with a layer of hexagonal boron nitride and combining chemical treatment, hexagonal boron nitride encapsulation, and argon annealing, the blinking issue was effectively resolved.
2. The yield increased with longer annealing times.

Acknowledgement

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References

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