Controlling the photoluminescence of quantum emitters in hexagonal boron nitride by applied magnetic fields

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Abstract

The recent observation of room temperature spin-dependent photoluminescence (PL) emission from hexagonal boron nitride's (h-BN's) defect centers makes them a highly interesting platform not only for quantum information science but also for quantum sensing applications. In this talk, we will discuss the PL emission dynamics of h-BN's visible single-photon emitters under an external out-of-plane magnetic field at liquid helium temperature. In particular, we found that the PL intensity of the emitters strikingly exhibits strong magnetic field dependence and decreases with the increased magnetic field. [1] A pronounced decrease in the integrated PL intensity of the emitters by up to one order of magnitude was observed when the applied field is increased from 0 T to 7 T. The observed reversible photodarkening of PL emission is in very well agreement with the predictions of a recent joint experimental and theoretical study [2] and can be attributed to the activation of very efficient non-radiative intersystem crossing transitions under applied magnetic field.

References

[1] Hilal Korkut and İbrahim Sarpkaya, 2D Materials, 10, 015004 (2023)

[2] Exarhos A L, Hopper D A, Patel R N, Doherty M W, and Bassett L C, Nat.Commun.,10 (2019)

Figures

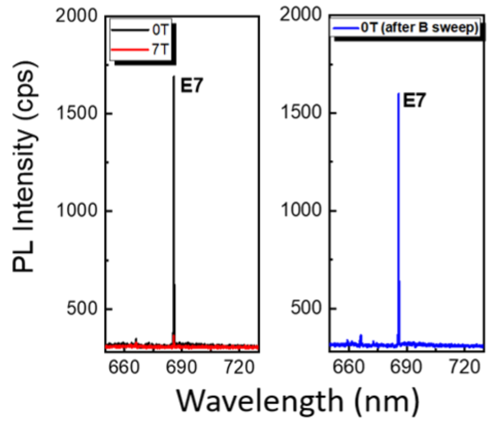

Figure 1: Left panel: Low-temperature PL spectra of h-BN defect emitter with (red line) and without (black line) external magnetic field. **Right panel:** PL spectrum of the same emitter after the magnetic field was removed.

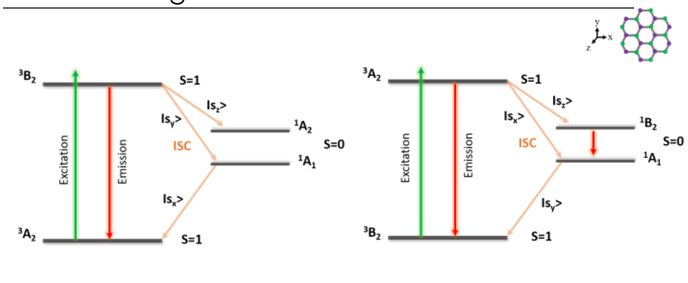

Figure 2: The electronic level structure to explain the observed photodarkening effect in the PL emission of the h-BN defect emitter.