Electronic Supplementary Material

Observation of coupling between zero- and two-dimensional semiconductor systems based on anomalous diamagnetic effects

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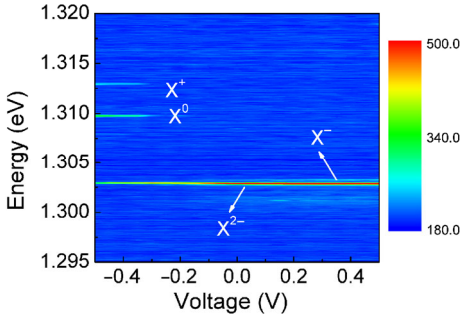

Figure S1 Contour plot of photoluminescence (PL) spectra of a single quantum dot as a function of bias voltage with a pumping power of 7.11 μW. Singly positively charged exciton (X^+), neutral exciton (X^0), singly negatively charged exciton (X^-), and doubly negatively charged exciton (X^{2-}) are clearly observed, as marked. The energy separations between X^+ (X^-) and X^0 are about 3–7 meV, which is due to Coulomb interaction in the quantum dot. However, the separation between X^{2-} and X^- is much smaller because the third electron of X^{2-} occupies the p-shell, resulting in a smaller Coulomb interaction [S1].

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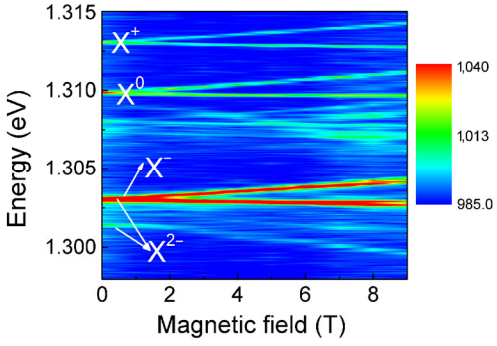

Figure S2 Zeeman splitting and diamagnetic shift of singly positively charged exciton (X^+), neutral exciton (X^0), singly negatively charged exciton (X^-), and doubly negatively charged exciton (X^{2-}) . The spectra were collected with a pumping power of 5.93 μW with a bias voltage at −0.5 V. The *g* factors are similar for all peaks in a range of 2 to 3. Peaks of X^+, X^0, X^-, and high energy brunch of X^{2-} show a positive diamagnetic shift with values around 6–7 μeV/T^2. The singlet branch of X^{2-} at low energy side shows a negative diamagnetic shift as reported before [S2].

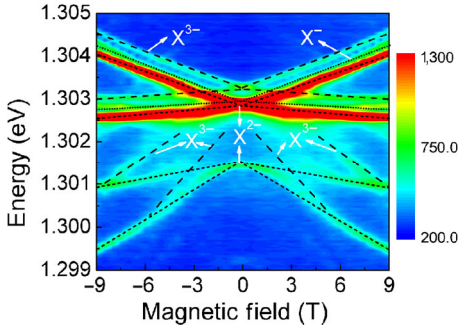

Figure S3 Enlarged contour plot of negatively charged excitons (X^-, X^{2-}, X^{3-}) as a function of an applied magnetic field with a pumping power at 7.11 μW. Anticrossings between X^{3-} and continuum states of wetting layer are observed, which are similar to what has been reported before [S2, S3].

References

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