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Bound excitons at the edges in monolayer tungsten disulfide VICTOR CAROZO, Pontifical Catholic University of Rio de Janeiro, YUANXI WANG, KAZUNORI FUJISAWA, The Pennsylvania State University, BRUNO R. CARVALHO, UFMG, CHANJING ZHOU, SIMIN FENG, ZHONG LIN, AMBER MCCREARY, NESTOR PEREA-LOPEZ, ANA LAURA ELIAS, BERND KABIUS, VINCENT H. CRESPI, MAURICIO TERRONES, The Pennsylvania State University — Defects play a significant role in tailoring the optical properties of two-dimensional materials. Optical signatures of defect-bound excitons are important tools to probe defective regions and thus interrogate the optical quality of as-grown semiconducting monolayer materials. We have performed a systematic study of defect-bound excitons using photoluminescence spectroscopy combined with atomically resolved scanning electron microscopy and first-principles calculations. Spatially resolved photoluminescence spectroscopy at low temperatures revealed bound excitons that were present only on the edges of the triangular islands and not in the interior. Atomic-resolution images reveal that the areal density of mono-sulfur vacancies is much larger near the edges (0.92 ± 0.45 nm^{-2}) than in the interior (0.33 ± 0.11 nm^{-2}). First-principles calculations confirm that sulfur mono-vacancies introduce mid-gap states that host optical transitions with finite matrix elements. These results demonstrate that bound exciton emission induced by mono-sulfur vacancies is concentrated near the edges in as-grown monolayer tungsten disulfide.

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