Exploring single atomic spin states in 2D flatland

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To control the spin state of an individual atom is an ultimate goal for spintronics. A single atom magnet, which may lead to a supercapacity memory device if realized, requires the high-spin state of an isolated individual atom. Here, we demonstrate the realization of well isolated transition metal (TM) atoms fixed at atomic defects sparsely dispersed in graphene. Core-level electron spectroscopy clearly reveals the high-spin state of the individual TM atoms at the divacancy or edge of the graphene layer. We also show for the first time that the spin state of single TM atoms systematically varies with the coordination of neighboring nitrogen or oxygen atoms. These structures can be thus regarded as the smallest components of spintronic devices with controlled magnetic behavior.

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