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Growth and Optical Properties of High-Quality WS_2 Monolayers on Graphite YASUMITSU MIYATA, YU KOBAYASHI, SHOGO SASAKI, SHOHEI MORI, YUTAKA MANIWA, Department of Physics, Tokyo Metropolitan University, KENJI WATANABE, TAKASHI TANIGUCHI, National Institute for Materials Science, HIROKI HIBINO, NTT Basic Research Laboratories, NTT Corporation — Atomic-layer transition metal dichalcogenides (TMDCs) have attracted appreciable interest due to their tunable bandgap, spin-valley physics, and potential device applications. However, the quality of TMDC samples available still poses serious problems, such as inhomogeneous lattice strain, charge doping, and structural defects. Here, we report on the growth of high-quality, monolayer WS_2 onto exfoliated graphite by high-temperature chemical vapor deposition (CVD). Monolayer WS_2 single crystals grown presents a uniform, single excitonic photoluminescence peak with a Lorentzian profile and a very small full-width at half maximum of 21 meV at room temperature and 8 meV at 79 K. Furthermore, in these samples, no additional peaks are observed for charged and/or bound excitons, even at low temperature. These optical responses are completely different from the results of previously reported TMDCs obtained by mechanical exfoliation and CVD. Our findings indicate that the combination of high-temperature CVD with cleaved graphite surface is an ideal condition for the growth of high-quality TMDCs, and such samples will be essential for revealing intrinsic physical properties and for future applications.

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