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Valley addressable exciton-polaritons in atomically thin $MoSe_2$

SCOTT DUFFERWIEL, T. P. LYONS, University of Sheffield, D. D. SOLYNSHKOV, Blaise Pascal University, A. A. P. TRICHET, University of Oxford, F. WITHERS, University of Manchester, S. SCHWARZ, University of Sheffield, G. MALPUECH, Blaise Pascal University, J. M. SMITH, University of Oxford, K. S. NOVOSELOV, University of Manchester, M. S. SKOLNICK, D. N. KRIZHANOVSKII, A. I. TARTAKOVSKII, University of Sheffield — While conventional semiconductor technology relies on the manipulation of electrical charge for the implementation of computational logic, additional degrees of freedom such as spin offer alternative avenues for the encoding of information. In TMD monolayers, where spin-valley locking is present, strong retention of valley chirality has been reported for MoS_2, WSe_2 and WS_2 while $MoSe_2$ shows low polarization retention. Here, we show that by placing monolayers of $MoSe_2$ in an optical microcavity in the strong light-matter coupling regime, the valley polarization is regained with an enhancement of up to 7X compared with the bare monolayer. Here, polaritons introduce a fast relaxation mechanism which inhibits full valley spin relaxation of reservoir excitons due to the Maialle-Sham mechanism and allows for increased retention of polarization. A dynamical model reproduces the detuning dependence through the incorporation of cavity-modified exciton relaxation, allowing an estimate of the spin relaxation which is an order of magnitude faster than those reported in other TMDs. The valley addressability demonstrates the prospect of valleytronic devices based upon $MoSe_2$ embedded in photonic structures.

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