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Ultrafast optical properties of the liquid phase exfoliated Antiferromagnetic 2D Semiconductor NiPS3

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Antiferromagnets (AFMs) are promising materials for spintronic and opto-electronic applications due to natural spin dynamics in the THz range and, at the same time, they have no net magnetization. This leads to the absence of stray fields which is a useful property for data storage applications. A promising approach here is to combine the unique magnetic properties of AFMs with the strong coupling of optical and magnetic properties of semiconductors. Recently, semiconducting AFMs attract a lot of attention with several studies focusing on van der Waals layered AFMs from metal phosphotrichalcogenides such as NiPS3, FePS3, and MnPS3. For our studies, we have chosen NiPS3 because of its non-trivial exciton behavior of Zhang-Rice singlet and triplet states. Beside of that the liquid phase exfoliation (LPE) of NiPS3 was performed to bring the bulk NiPS3 crystals into the low-dimension phase. Depending on the conditions of the LPE the size of the low dimensional flakes of material are formed which leads to their different optical properties.
In order to investigate light-induced spin dynamics of the excited state and electronic populations in semiconducting NiPS3, we use time-resolved transient absorption (TA) at cryogenic temperatures. This technique provides access to spectral information about changes in absorption induced by the excitation of non-equilibrium carrier populations and the dynamics of the carrier and exciton recombination. We will further report our results on time and spectrally resolved optical detection of the Neel vector at cryogenic temperatures through complex Zhang-Rice multiplet excitonic states of NiPS3 antiferromagnet by measuring the polarization properties of absorbed and emitted light.

Topics

Session A. Physics of condensed matter and spectroscopy

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