PCSI

Room Ballroom South - Session PCSI-2MoA

Spectroscopy of 2D Materials

Moderator: Kimberly Thelander, Lund University

2:55pm **PCSI-2MoA-12 Light Matter Interaction in Tunable 2D Materials and Artificial van der Waals Solids**, ***Ursula Wurstbauer***, University of Münster, Germany **INVITED**

Atomically thin two-dimensional layered materials receive great interest because of their unique properties. Particularly, monolayers of semiconducting transition metal dichalcogenides (SC-TMDs), such as MoS_2, excel due to their strong light-matter interaction that is dominated by exciton phenomena [1-3]. Key to the integration of SC-TDM and related artificial van der Waals solids into circuitries is the possibility to tune and engineer their properties on demand and on-chip e.g. by defects, dielectric environment or doping [4-7].

We apply inelastic light scattering together with emission, absorption and transport measurements to study the manifold coupling mechanism in van der Waal hetero- and hybrid structures. We introduce the influence of the dielectric environment, the charge carrier density as well as defects on the optical properties of these atomically thin materials and discuss consequences for their integration into optoelectronic circuits [8]. Moreover, optical properties of direct and indirect interlayer excitons in van der Waals heterostructures are addressed.

We acknowledge the financial support by the Deutsche Forschungsgemeinschaft (DFG) via excellence cluster Nanosystems Initiative Munich (NIM) as well as DFG project WU 637/4-1.

[1] U. Wurstbauer, et al. J. Phys. D: Appl. Phys. 50, 173001 (2017).

[2] S. Funke, et al., J. Phys.: Condens. Matter 28, 385301 (2016).

[3] B. Miller, et al., Nano Lett. 17(9), 5229–5237 (2017).

[4] S. Diefenbach, et al., J. Phys. Chem. C, 122 (17), 9663–9670 (2018).

[5] J. Klein, et al., 2D Materials 5, 011007 (2018).

[6] J. Wierzbowski, et al., Nature Scientific Reports 7, 12383 (2017).

[7] B. Miller, et al., Appl. Phys. Lett. 106, 122103 (2015).

[8] E. Parzinger, et al., Nature 2D material 1, 40 (2017).

3:25pm **PCSI-2MoA-18 Ultrafast Enhancement of Interfacial Exchange Coupling in Ferromagnetic Co_2FeAl/(Ga,Mn)As Bilayer**, ***Gunter Luepke***, College of William & Mary

Fast spin manipulation in low-dimensional magnetic heterostructures, where magnetic interactions between different materials often define the functionality of devices, is a key issue in the development of ultrafast spintronics. Although recently developed optical approaches such as ultrafast spin-transfer and spin-orbit torques open new pathways to fast spin manipulation, these processes do not utilize the unique possibilities offered by interfacial magnetic coupling effects in ferromagnetic multilayer systems. Here, we experimentally demonstrate ultrafast photoenhanced interfacial exchange interactions in the ferromagnetic Co_2FeAl/(Ga,Mn)As system at low laser fluence levels [1]. The excitation efficiency is 30-40 times higher than without the (Ga,Mn)As layer due to *p-d* exchange interaction between photoexcited holes and Mn spins (Fig. 1). The coherent spin precessions persist to room temperature, indicating that proximity-induced ferromagnetism plays a key role in the optical excitation mechanism. The results highlight the importance of considering the range of interfacial exchange interactions in low-dimensional heterostructures and how these magnetic coupling effects can be utilized for ultrafast, low-power spin manipulation.

Author Index

Bold page numbers indicate presenter