CRC Seminar Series

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LOC: Online

GUEST SPEAKER:
Professor Ursula Wurstbauer
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TITLE:
“Light-matter Interaction in 2D Polar Metals and TMDC Hybrids”

ABSTRACT:
Central to all optical technologies is the manipulation of the light-matter interaction to achieve a high level of control, particularly in technologically relevant solid-state nanomaterials. Here, we study the optical response of 2D polar metals such as 2D gallium (Ga) and 2D indium (In) embedded in half-van der Waals heterostructures[1] and hybrid structures with semiconducting TMDCs. The 2D metals exhibit fascinating properties like superconductivity[1] strong plasmonic response in the visible range, and strong nonlinear optical properties emerging by giant second harmonic generation in the NIR range[3]. Due to the half-van der Waals nature, the 2D metals can be combined with other van der Waals materials to achieve novel functionalities.

In a systematic experimental and theoretical study of the dielectric functions of 2D films, we identify *k*-space resolved free electron and bound electron contributions to the optical response, with the latter pointing towards the existence of thickness dependent quantum confinement phenomena[4]. The resonance energies in the dielectric functions and the observed epsilon near zero (ENZ) behavior in the near infrared to visible spectral range are dependent on number of atomic metal layers and materials and alloying. Their tunability and possibility for integration in van der Waals heterostacks makes 2D polar metals attractive for quantum engineered metal films, tunable (quantum-)plasmonics and nano-photonics.

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References

1. N. Briggs *et al., Nanoscale* **2019**, *11*, 1544 – 1547.
2. N. Briggs *et al., Nature Materials* **2020***, 19*, 637-643.
3. M. A. Steves *et al., submitted* **2020***,* arXiv:2004.01809.
4. K. Nisi *et al., submitted* **2020**.

PROFILE OF PROFESSOR URSULA WURSTBAUER:

Ursula Wurstbauer holds a degree in Physics from the University of Regensburg in 2006, where she also received her PhD under supervision of Prof. Werner Wegscheider in 2008. After postdoc stays at Hamburg University and Columbia University in the City of New York (USA), she became in 2013 a junior group leader at the Walter Schottky Institute at the Technical University of Munich and was a principal investigator of the DFG cluster of excellence “Nanosystems Initiative Munich” (NIM) and is a principal investigator in the excellence initiative “e-conversion”. Since 2019, she is professor for nanolectronics at the Institute of Physics at Münster University. Her current research focuses focus on emergent and interaction driven phenomena of two-dimensional materials, two-dimensional charge carrier systems, related hetero-, and hybrid structures.