Interaction of 2D Materials with Laser-Written Waveguide Circuits

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The remarkable optical properties of monolayer transition metal dichalcogenides (TMDs) are determined by strongly-bound excitons. Currently, micro-photoluminescence measurements are typically performed with light polarized in the plane of the TMD layer. However, so-called dark excitons in TMDs that emit z-polarized light propagating along the TMD layer are notoriously difficult to access since they require side-on detection [1, 2].

Our intention is to efficiently probe TMDs in this direction by depositing them onto a fused silica glass substrate containing femtosecond laser direct written waveguides [3]. By defining a waveguide near the surface of the glass, light propagating in it is brought into close proximity of the sample. In this vein, interactions of the waveguide's evanescent field and the sample are enabled over distances only limited by the size of the flake. Likewise, coupling of exciton emissions into the waveguide can be achieved.

Our micro-photoluminescence setup that couples into the sides of the waveguide and simultaneously detects light perpendicular to the TMD layer has the potential to excite and detect the x,y and z polarization of the photoluminescence signal, allowing for direct observations of dark excitons and giving new insights into their nature.

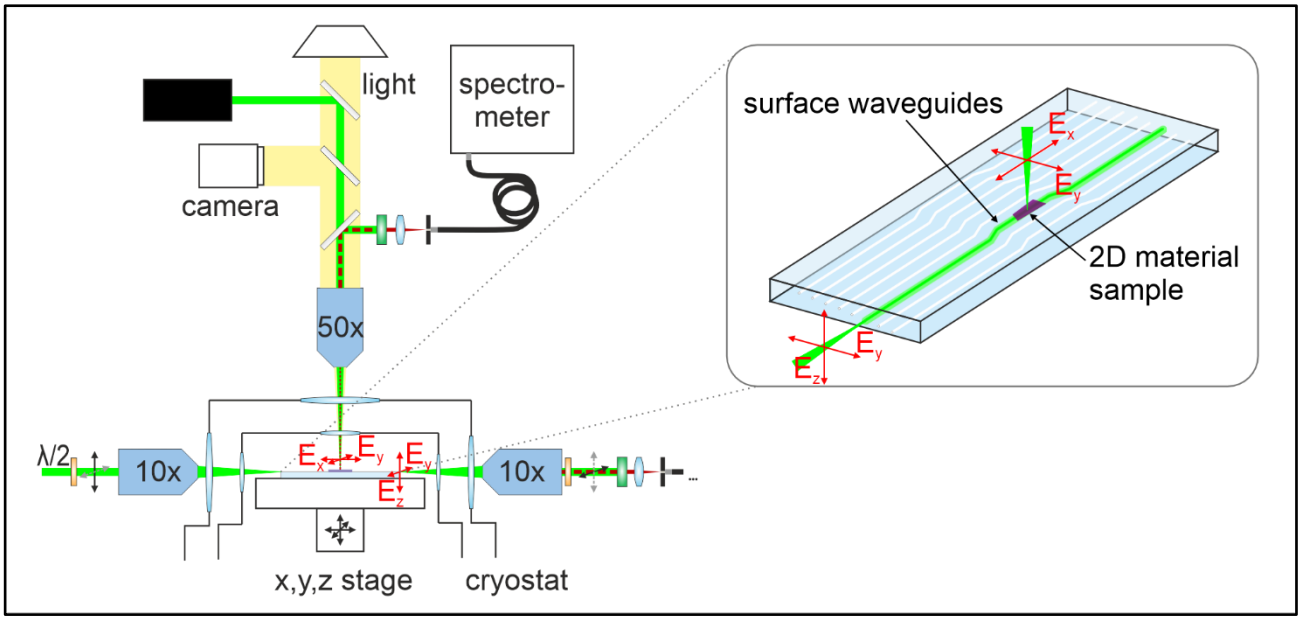

Fig.1. Schematic micro-photoluminescence setup for top and side excitation and collection with focus on the interaction of the surface waveguide with 2D material samples

References

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