

Supplementary information for

Exciton and charge carrier dynamics in few-layer WS₂

Victor Vega-Mayoral^a, Daniele Vella^a, Tetiana Borzda^a, Matej Prijatelj^a, Iacopo Tempra^b, Eva A. A. Pogna^b, Stefano Dal Conte^b, Peter Topolovsek^c, Natasa Vujcic^d, Giulio Cerullo^b, Dragan Mihailovic^e and Christoph Gadermaier^a.

- a. Department of Complex matter, Jozef Stefan Institute. Jamova cesta 39, 1000 Ljubljana Slovenia.
Jozef Stefan International Postgraduate school. Jamova cesta 39, 1000 Ljubljana Slovenia.
- b. IFN-CNR, Department of Physics, Politecnico de Milano, P. Leonardo da Vinci, 32, Milan, Italy.
- c. Center for Nano science and technology, Italian institute of technology, Via Pascoli 70/3, 20133, Milano Italy.
Jozef Stefan International Postgraduate school. Jamova cesta 39, 1000 Ljubljana Slovenia.
- d. Institute of Physics, Bijenicka 46, 10000 Zagreb, Croatia.
- e. Department of Complex matter, Jozef Stefan Institute. Jamova cesta 39, 1000 Ljubljana Slovenia.
Jozef Stefan International Postgraduate school. Jamova cesta 39, 1000 Ljubljana Slovenia.
Center of Excellence in Nanoscience and Nanotechnology, Jamova 39, 1000 Ljubljana, Slovenia

Experimental Section

WS₂ sample preparation: 1 mg of WS₂ in water/ethanol mixture (Graphene Supermarket) was extracted by flocculation with the addition of KCl (Potassium Chloride ≥99.0 %; Sigma) into a solution. Obtained flocculates were repeatedly washed with Millipore water to remove any salt residues. Finally, the water was removed and the sample was dried in an oven at 90 °C overnight. 2 ml of chlorobenzene was added to the vial with WS₂ and redispersed in an ultrasonic bath for 1 h. 50 mg of PMMA (avg. MW~350,000; Aldrich) was added into a solution of WS₂ and additionally sonicated at 50 °C for 30 min. 30 µl of the obtained stable solution was drop-cast onto a quartz substrate and left to dry in air.

Femtosecond pump-probe spectroscopy: femtosecond pump-probe spectroscopy setup is driven by an amplified Ti:sapphire laser (Coherent Libra) producing 4-mJ, 100-fs, 1.55-eV pulses at 1-kHz repetition rate. A fraction of the pulse energy is focused in a BBO crystal and its frequency is doubled. Then 3.1 eV

photons will conform the pump pulse. Another fraction of the pulse energy is focused in a 3 mm thick sapphire plate to generate a single-filament white light continuum used as a probe. Pump and probe are non-collinearly focused on the sample and the transmitted probe spectrum is detected by a spectrometer working at the full 1-kHz repetition rate of the laser. $\Delta T/T$ spectra are recorded with a time resolution of ≈ 100 fs and a sensitivity of $1 \div 2 \times 10^{-5}$.