Nanosecond carrier and barrier dynamics at a van der Waals Schottky junction observed by optical pump-probe atomic force microscopy

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Transition metal dichalcogenides (TMDCs) are promising materials for next-generation optoelectronic devices. Schottky junctions based on TMDCs play an essential role in high-speed and highly sensitive photodetectors. The carrier dynamics in these junctions are strongly linked to the temporal evolution of the Schottky barrier potential, yet their nanosecond-scale behavior under applied bias remains unclear.

We performed optical pump–probe atomic force microscopy (AFM) measurements on a Schottky junction formed between a bulk WSe_2 and a PtIr cantilever in contact-mode AFM. Time-resolved current measurements using the delay-time modulation technique [1, 2] revealed distinct responses depending on bias voltage and laser intensity (Figure). These results indicate characteristic carrier dynamics unique to van der Waals Schottky junctions, which will be discussed together with transient absorption spectroscopy [3], light-modulated *I*-*V*, and numerical model analysis.

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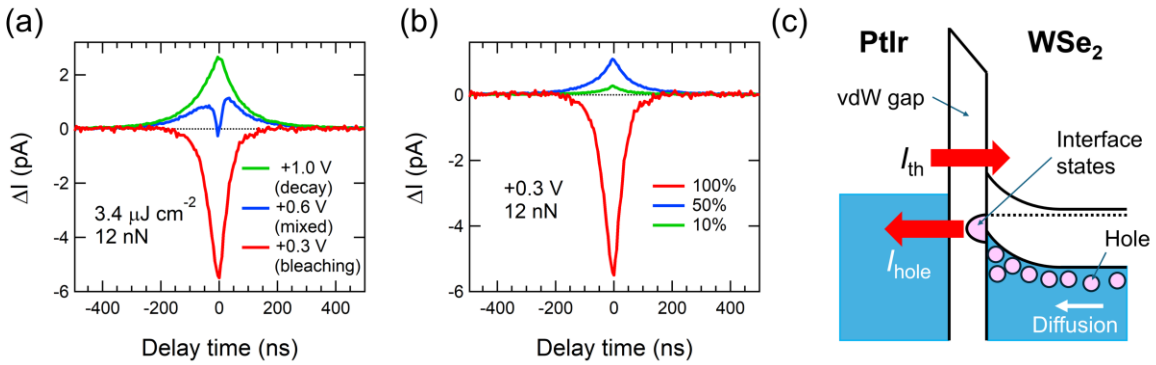

Figure (a) Bias dependence of time-resolved current (b) Laser intensity dependence of time-resolved current (c) Schematic illustration of the band structures of *n*-type WSe_2 and PtIr at $V > 0$ with laser illumination. I_{th}: thermionic current, I_{hole}: hole current.