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Picosecond resolution time resolved photoelectron emission detection system

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The lifetime of hot carriers in materials following photoexcitation is a critical factor influencing their potential for various applications, including solar energy conversion, surface chemistry, optoelectronic devices, etc. We have developed a time-resolved photoelectron emission detection system to experimentally study hot carriers in diverse materials. This system employs an advanced Radio Frequency Timing (RFT) technique, where RF-synchronized ~258 nm photons are directed at the sample target. The emitted photoelectrons are accelerated to ~2.5 kV, scanned using a dedicated circular scanning deflector operating at 500–1000 MHz, and subsequently focused and detected by a position-sensitive detector composed of dual chevron microchannel plates and a delay-line anode. By converting the time of arrival of incident electrons into a hit position on a circle, the system achieves ~10-picosecond temporal resolution for single electrons. Experimental results for gold and graphene are presented: no delayed electrons were observed from gold, whereas graphene exhibited delayed electrons clearly detectable up to the nanosecond range. Current efforts focus on achieving sub-10-picosecond resolution.

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