Supporting Information for

Synthesis, Characterization and Fabrication of Ultrathin Iron Pyrite (FeS$_2$) Thin Films and Field-effect Transistors

Xi Liu$^{a,b,c}$, Zhaojun Liu$^{a,b,c}$, Jacob Y. L. Ho$^{c}$, Man Wong$^{c}$, and Hoi Sing Kwok$^{c}$

$^a$ Sun Yat-sen University–Carnegie Mellon University Joint Institute of Engineering, Sun Yat-sen University, Guangzhou, China. E-mail: eezhj@ust.hk

$^b$ Sun Yat-sen University–Carnegie Mellon University Shunde International Joint Research Institute, Sun Yat-sen University, Guangdong, China

$^c$ State Key Lab on Advanced Displays and Optoelectronics, Department of Electronic and Computer Engineering, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong

*To whom correspondence should be addressed. E-mail: eezhj@ust.hk
I. Calculation of the Device Parameters

Table 2 in the main text lists a few device parameters that were calculated. The capacitance of oxide is calculated from \( C_{ox} = (\varepsilon_{SiO_2} \varepsilon_0) / T_{ox} \).

The on and off current is the average current of the corresponding region in the Ids vs. Vds plot. The \( I_{on}/I_{off} \) ratio is simply the ratio of the on and off current, and the On-state resistance is the average resistance from the on state region.

The mobility is determined from the following equation:

\[
I_D = \mu C_{ox} \frac{W}{L} (V_{GS} - V_T) V_{DS}, \quad \text{for} \quad |V_{DS}| \ll (V_{GS} - V_T),
\]

which is the standard equation used to calculate the MOSFET biased with a small drain-to-source voltage in the linear region.

Resistivity \( (\rho) \) is based on the device diameter and the resistance at \( V_g=0 \) V. In our case, the FeS\(_2\) thin film is highly doped, and the carrier concentration of the device can be calculated from \( n = \frac{1}{q\mu \rho} \).

II. Structure characterization and optical properties of FeS\(_2\) thin film on quartz substrate
**Figure S1.** Raman spectrum of FeS$_2$ thin film on quartz.

**Figure S2.** Optical properties of FeS$_2$ thin film on quartz.

The optical measurement is conducted by a Lambda 20 (Perkin Elmer) UV/VIS Spectrophotometer. The result is a direct measurement of the sample with the substrate. Hence the reflection and transmittant of the substrate is not remove.