Tungsten Diselenide Diode Circuits Integrated with Oxide Capacitor for Radio Frequency AM Demodulation

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Two dimensional (2D) semiconductors have been extensively studied in many device applications. Yet, 2D device applications for high frequency AC input are rare in report and high frequency diode applications are more difficult to find. It is probably because most of 2D material-based electronic devices including diode have mainly focused on very thin 2D semiconducting layers, which mostly go through parasitic resistance and contact resistance. [1] Here we show a high frequency rectification Schottky diode using a few tens nm-thick Tungsten Diselenide (WSe$_2$), of which the top half surface contacts with a transparent Schottky electrode using conducting oxide, so that the device rather shows a vertical structure with transparent window to receive photons. The other half surface of WSe$_2$ in our Schottky diode is electrically isolated by thin aluminum oxide which becomes a parallel capacitor integrated for the diode circuits. Our Schottky diode circuits successfully demonstrate RF frequency rectification and demodulation of AM audio signals. [2, 3] The vertical WSe$_2$ Schottky diode circuits are easy to fabricate and their performances are reproducible, providing a new pathway toward future high frequency nanoelectronics.

References

[1]   A. Allain *et al.*, Nat. Mater., **14** (2015), 1195-1205
[2]   B. Razavi, "Fundamentals of Microelectronics", John Wiley & Sons, (2008), 88-99
[3]   W. Zhu *et al.*, Nano Lett., **15** (2015), 1883-1890

Figures
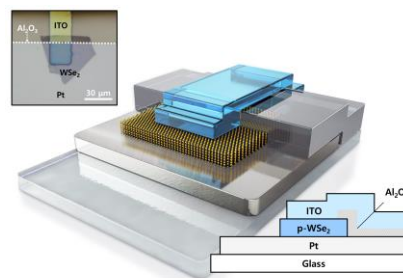

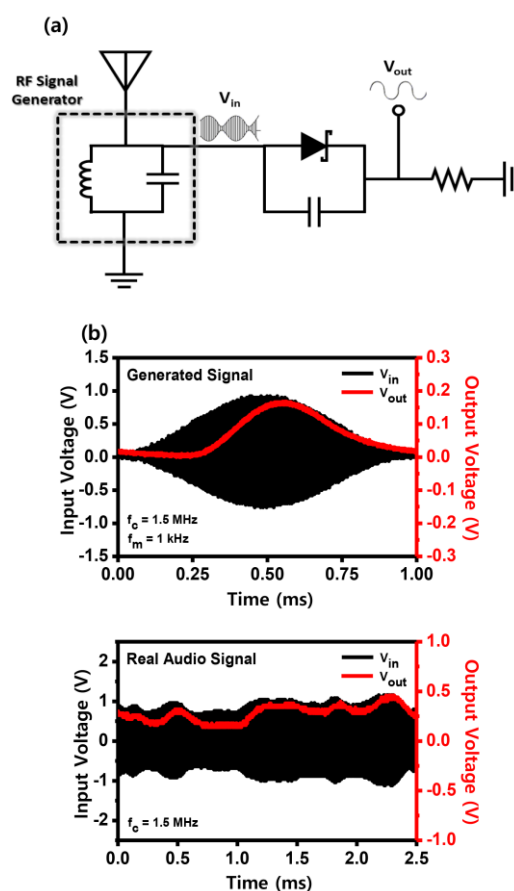**Figure 1:** Device schematic diagram of ITO/p-WSe$_2$ Schottky diode.

Figure 2: AM Radio Receiver. (a) Circuit diagram of AM radio receiver. (b) Time domain at a carrier frequency of 1.5 MHz with a modulating frequency of 1 kHz and real audio signal.