

**Electronic Supplementary material**

**Sensitive detection of L-Cysteine using highly stable  
Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> (MXene) nanocomposite modified glassy  
carbon electrode**

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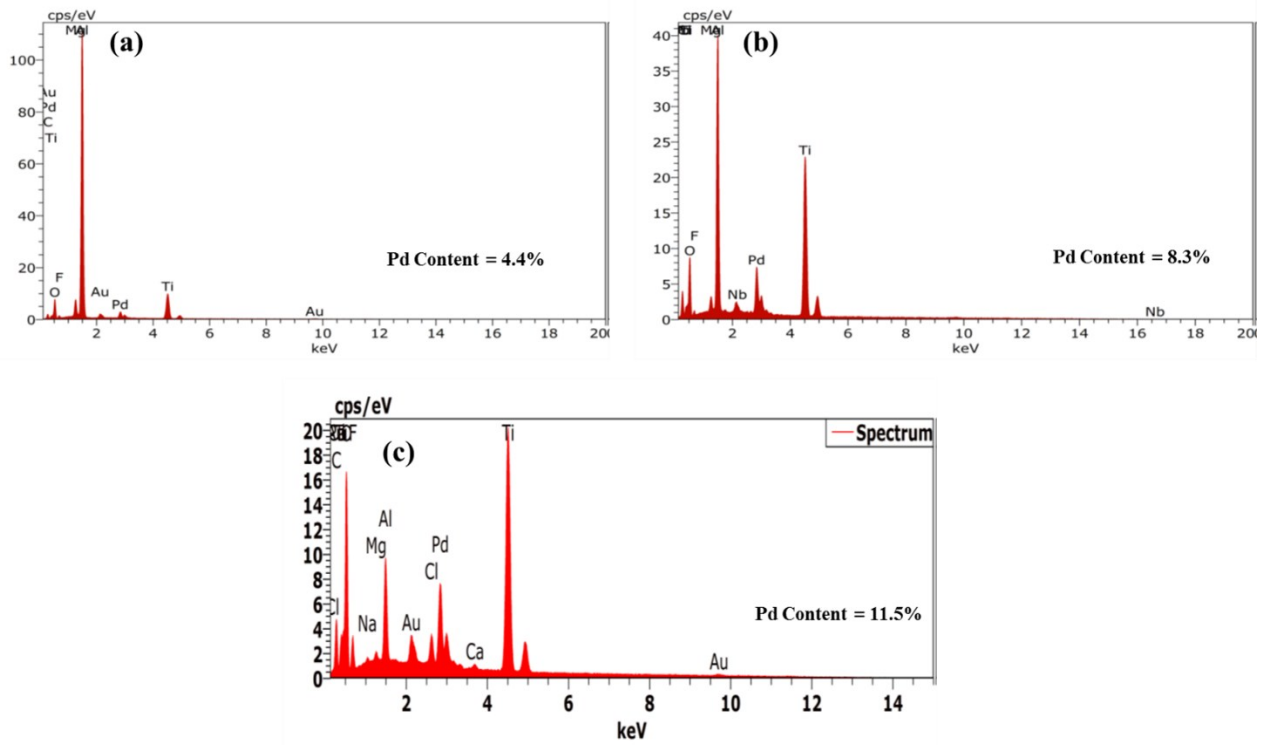


Fig. S1. EDS spectra of (a) 10%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>, (b) 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> and (c) 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> composites

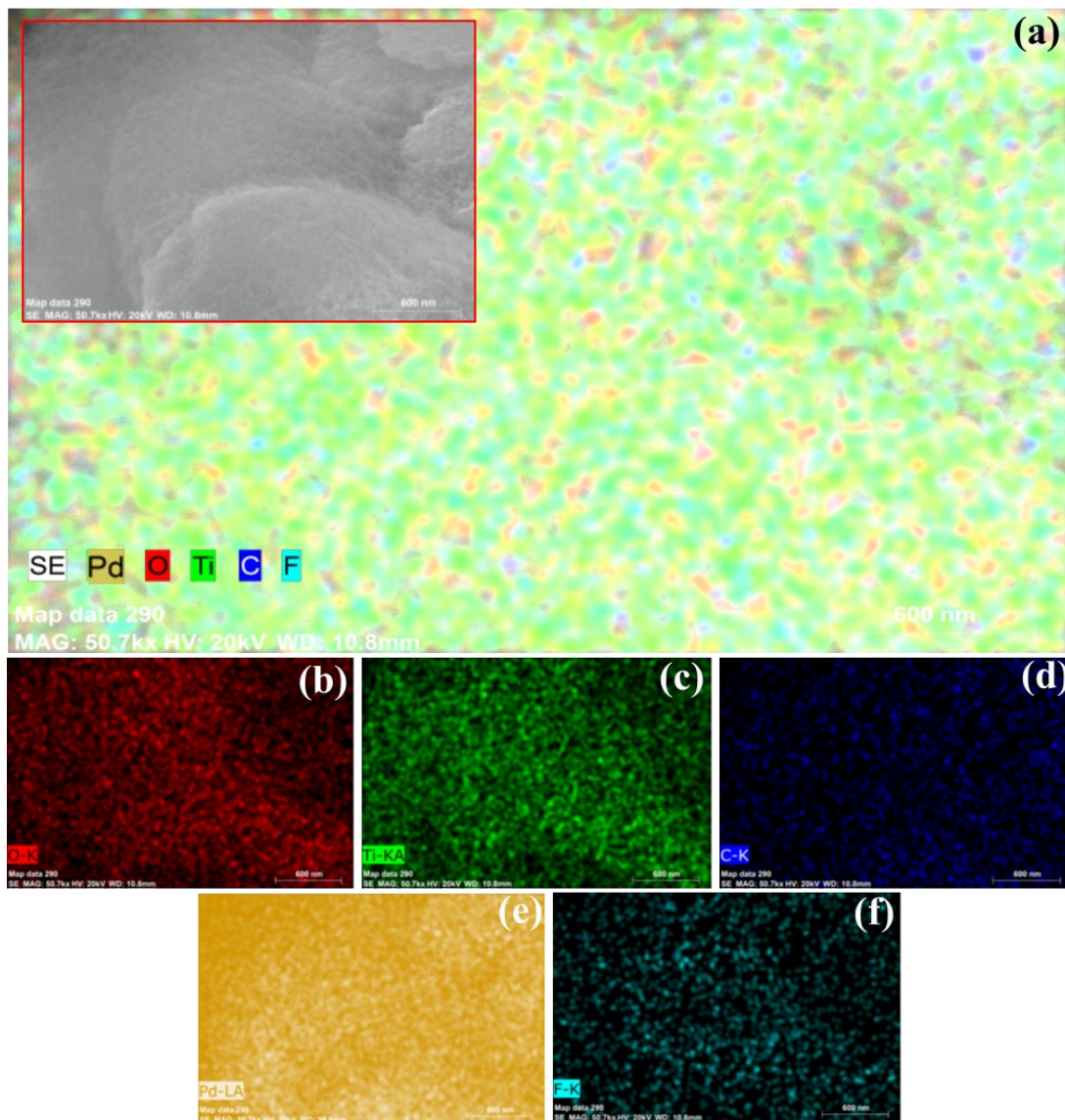


Figure S2. (a) Energy dispersive spectroscopy (EDS) elemental mix mapping image of Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> composite. Inset shows the SEM image of Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> composite; (b-f) Energy dispersive spectroscopy EDS elemental mapping of Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> composite with separate elements.

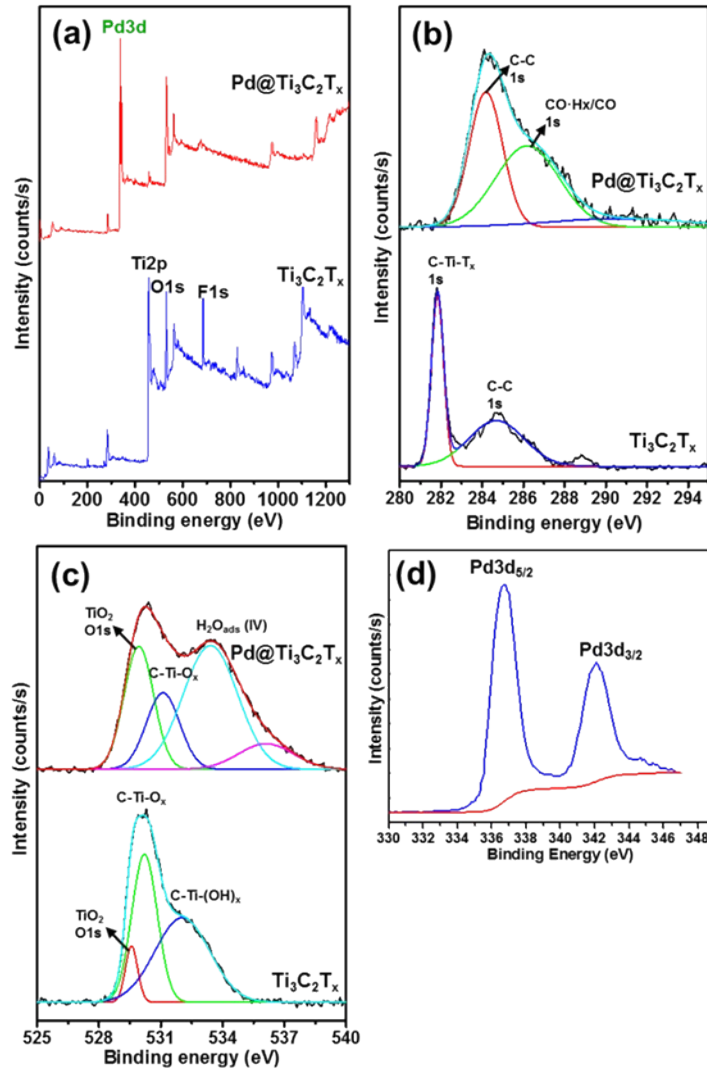


Fig. S3. (a), XPS survey spectra for Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> and Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>; (b) high resolution XPS spectrum for C 1s; (c) high resolution XPS spectrum for O 1s for Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub> and Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>; and (d) high resolution XPS spectrum of Pd 3d for the Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>.

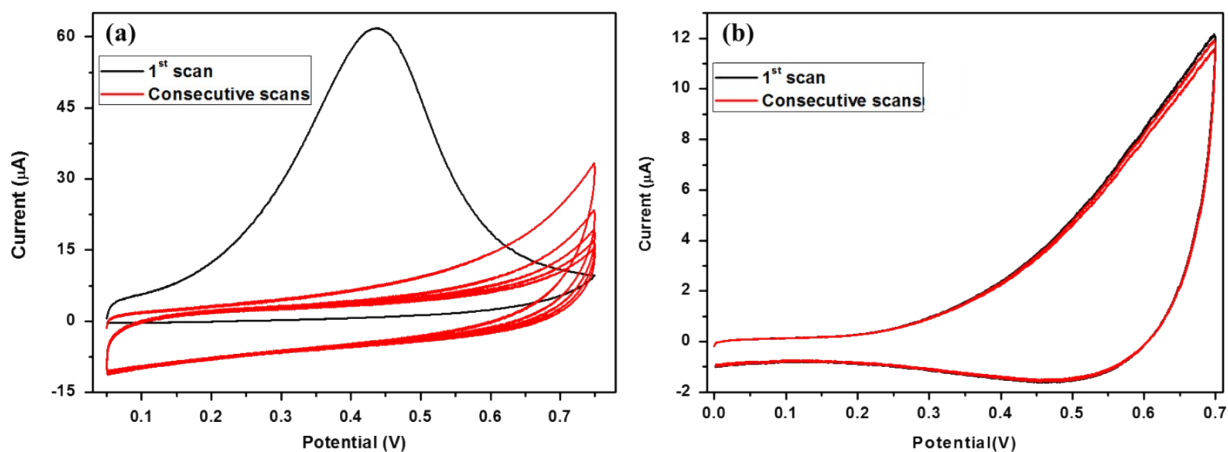


Fig. S4. (a) Cyclic voltammogram of  $\text{Ti}_3\text{C}_2\text{T}_x/\text{GCE}$  showing several consecutive scans run in a potential window from 0 V to 0.8 V at a sweep rate of  $100 \text{ mV s}^{-1}$  in 0.1 M PB (pH 7.0). (b) Cyclic voltammogram of 20%Pd@ $\text{Ti}_3\text{C}_2\text{T}_x/\text{GCE}$  showing several consecutive scans run in a potential window from 0 V to 0.7 V at a sweep rate of  $100 \text{ mV s}^{-1}$  in 0.1 M PBS (pH 7.0).

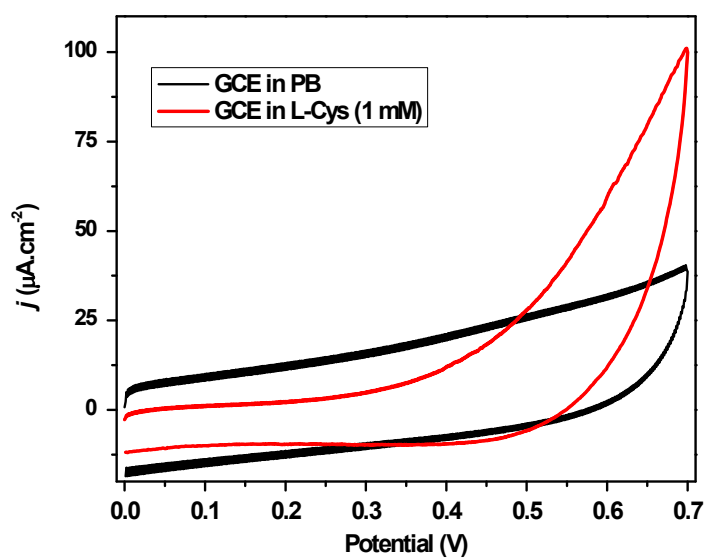


Fig. S5. Cyclic voltammogram of bare GCE in absence and presence of 1 mM L-Cys.

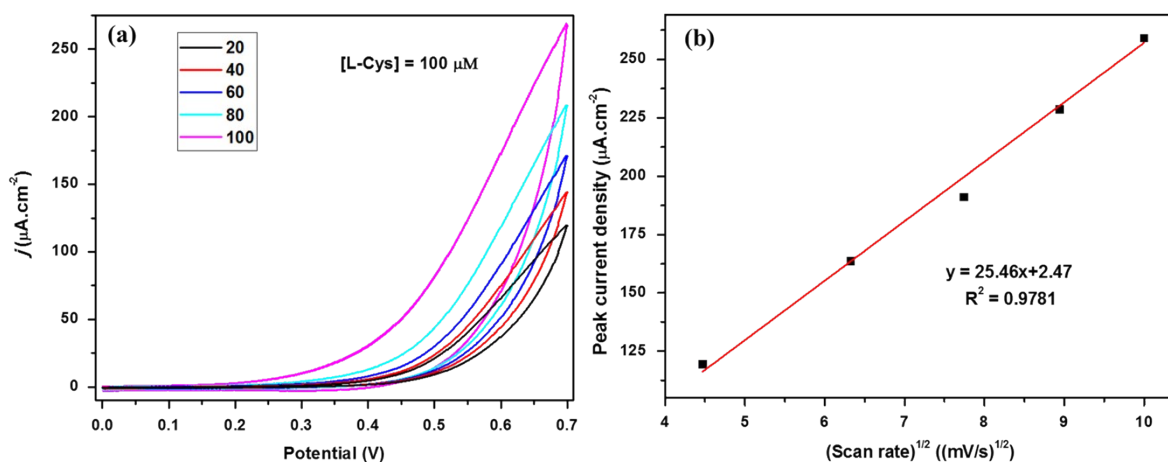


Fig. S6. (a) Cyclic voltammogram of 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>/GCE modified electrode in 0.1 M PB (pH 7) with the presence of 100  $\mu\text{M}$  L-Cys scanning at different scan rates. (b) Plot of peak current as a function of scan rate ranging from 20 to 100  $\text{mV}\cdot\text{s}^{-1}$ .

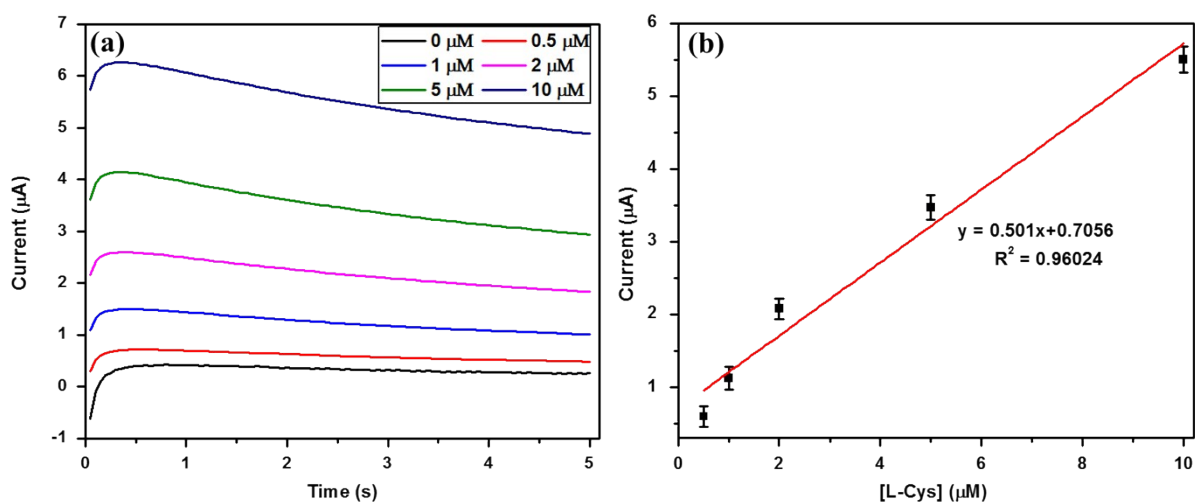


Fig. S7. (a) Chronoamperometric response of 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>/GCE electrode with different concentrations of L-Cys at +0.6V. (b) Plot of current vs molar concentration. The error bar indicates the standard deviation from the three independent measurements.

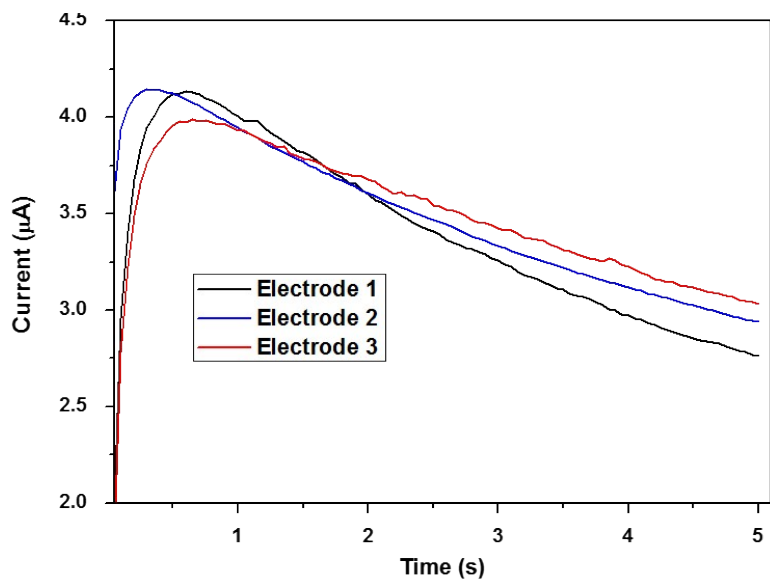


Fig. S8. Chronoamperometric curves of three different 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>/GCE with 5 μM L-Cys showing the repeatability of the sensor.

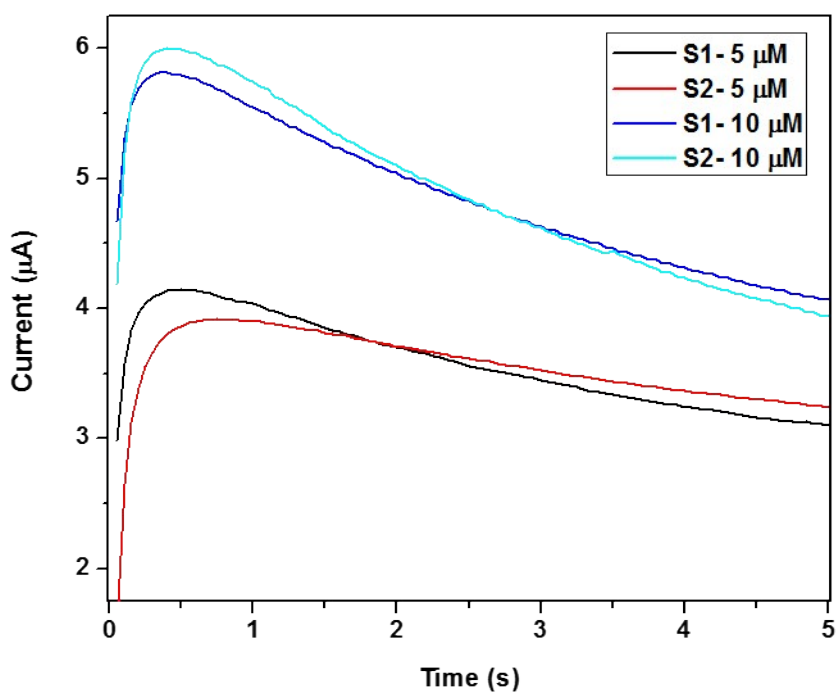


Fig. S9. Chronoamperometric response of 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>/GCE electrode with different concentrations of L-Cys spiked in human urine.

**Table S1:** Recovery of L-Cys in human urine samples by using the 20%Pd@Ti<sub>3</sub>C<sub>2</sub>T<sub>x</sub>/GCE.

<i>Samples</i>	<i>L-Cys added</i> ( $\mu$ M)	<i>L-Cys detected</i> ( $\mu$ M)	<i>Recovery (%)</i>	<i>RSD (%)</i>
<b>S1</b>	5	4.67	93.57	2.6
	10	9.54	95.43	3.83
<b>S2</b>	5	5.17	103.4	4.16
	10	9.64	96.95	4.72