Supplementary Material

A new hybrid sensitive PANI/SWCNT/Ferrocene-based layer for a wearable CO sensor

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Figure S1. (a) Layout interdigitated sensor, (b) Area with interdigitated electrodes.
**Figure S2.** Diagram with measuring installation. (a) CO cylinder, (b) N₂ cylinder, (c) Mass flow controller for CO, (d) Mass flow controller for N₂, (e) Gas mixing compartment, (f) GID sensor used for CO testing, (g) Source and multimeter, (h) Software.

**Figure S3.** (a) PANI/SWCNT, (b) PANI:PSS(3.2%)/SWCNT

**Figure S4.** Sensors with 0, 6, 8, 15, 25, 40 and 70 CV cycles.
Figure S5. XPS survey spectra of the: (a) PANI; (b) PANI:PSS/SWCNT; (c) PANI:PSS/SWCNT/Fc;

Figure S6. XRD for PANI, Ferrocene and PANI:PSS:SWCNT:Fc

Figure S7. Polyaniline as Emeraldine salt, in sulfuric acid media.

Adsorption-desorption kinetics
The Langmuir adsorption model for CO gas adsorption-desorption kinetics was used on the new hybrid layer, PANI:PSS/SWCNT/Fc using the method previously reported in [56]. Using the Langmuir adsorption model (1st order Langmuir Adsorption-desorption kinetics) the conductive data of sensor response and recovery are fitted with the first exponential rise and decay curves, respectively. This model considers that only top layer participates in CO adsorption and CO molecules are adsorbed by nitrogen atoms of PANI. The reaction may occur via reaction:

\[ \text{CO} + e^- \xrightleftharpoons[k^{-}/k^+]{k} \text{CO}^{\text{ads}} \]

Firstly, the resistive data of response and recovery curves are converted into conductive data and normalized. The conductive data of response was fitted with exponential rise and the recovery data was fitted with exponential decay. The conductance changes for response and for recovery according to [56] are presented below:

\[ \Delta \mathcal{G} = \Delta \mathcal{G}_{\text{max}} \left[ 1 - \exp \left( -\frac{1}{t_{\text{res}}} \right) \right], \text{ for response cycle} \]

\[ \Delta \mathcal{G} = \Delta \mathcal{G}_{\text{max}} \cdot \exp \left( -\frac{1}{t_{\text{rec}}} \right), \text{ for recovery cycle} \]

where, $\Delta \mathcal{G}$ and $\Delta \mathcal{G}_{\text{max}}$ are time dependent change of conductance and the change of maximum conductance, respectively.

By taking the natural logarithms on both sides, the exponential equation can convert in straight lines and $1/t_{\text{res}}$ and $1/t_{\text{rec}}$ represent the slopes and $t_{\text{res}}$ and $t_{\text{rec}}$ can be evaluated at various concentrations of gas (Figure S8 (b) and Figure S8(c)).

**Figure S8a.** presents the normalized conductance versus time after 300 ppm CO. The calculated response (Fig S8b) for 300 ppm CO was 33 seconds and for recovery (FigS8c) was 143 seconds. For lower concentrations < 100 ppm, the response time was smaller than 30 s and the and recovery time was smaller than 100s.
Figure S8. (a) Fitted response and recovery curve of PANI:PSS/SWCNT/Fc in presence of 300ppm CO$_2$ (b) logarithmic dependence of ln (1-Normalized $\Delta G$) and (c) logarithmic dependence of Normalized $\Delta G$ to obtain $1/t_{res}$ and respectively $1/t_{rec}$.