One-Step synthesis of Carbon Doped Ppy Nanoparticles interspersed 3D Porous Melamine Foam for high performance Piezoresistive Pressure, Strain, and breath Sensor

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#Equal contribution

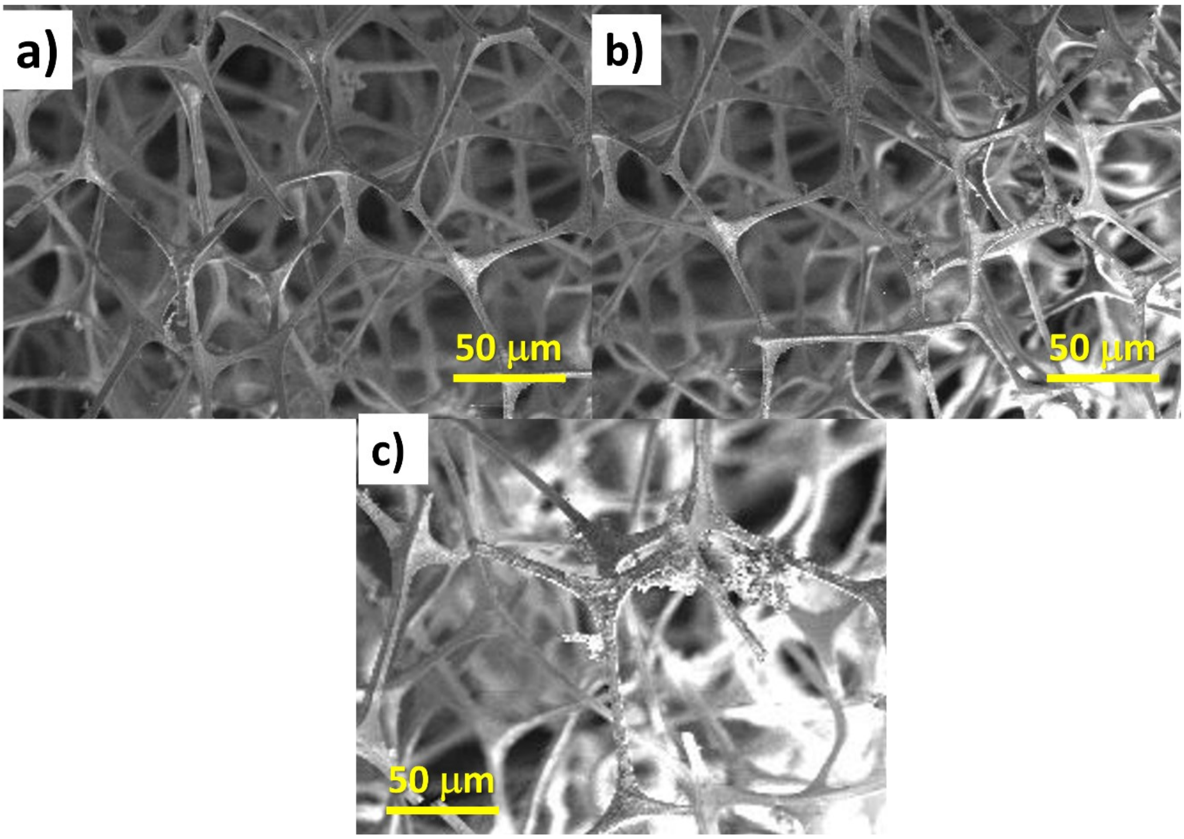


Figure S1. High magnification images of a) 1wt.%, b) 3 wt% c) 4 wt% of C-PPY@MF

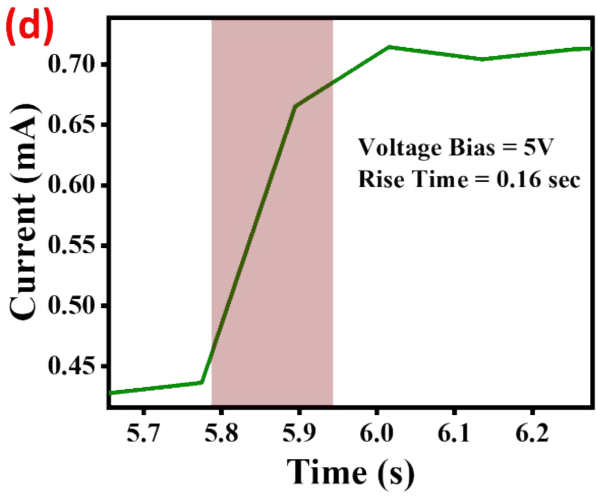


Figure S2: Response time of pressure sensor

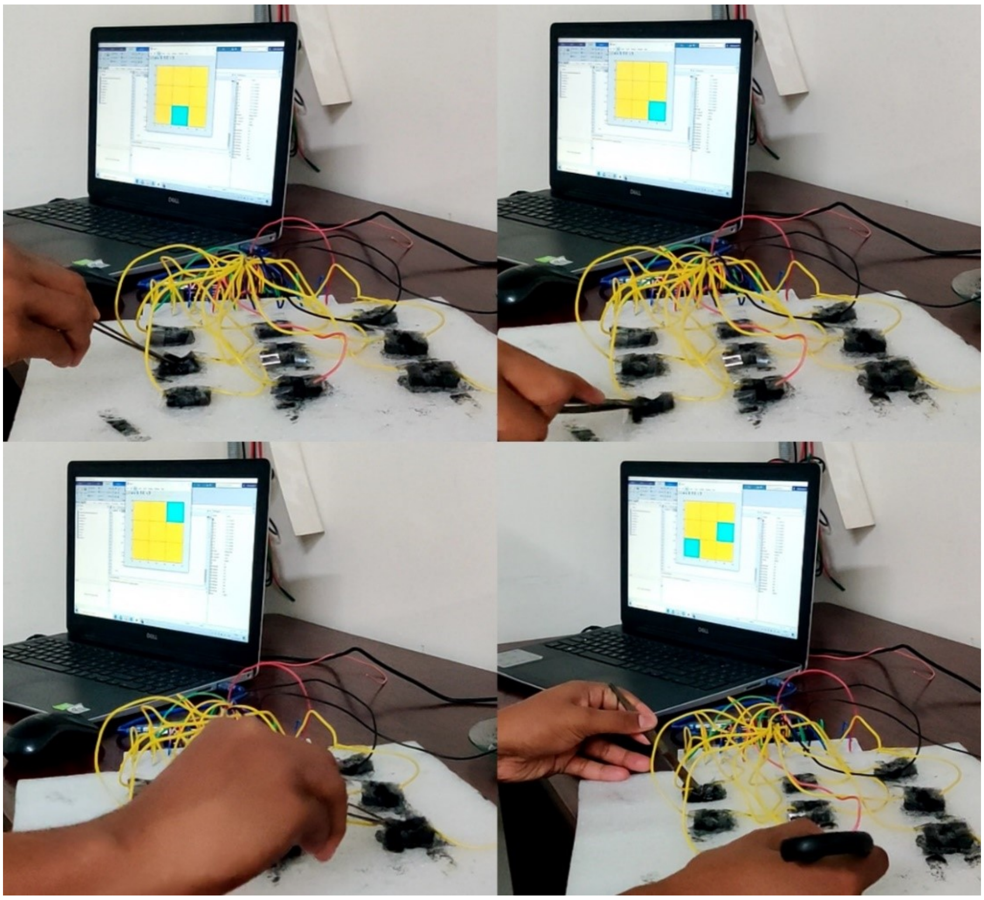
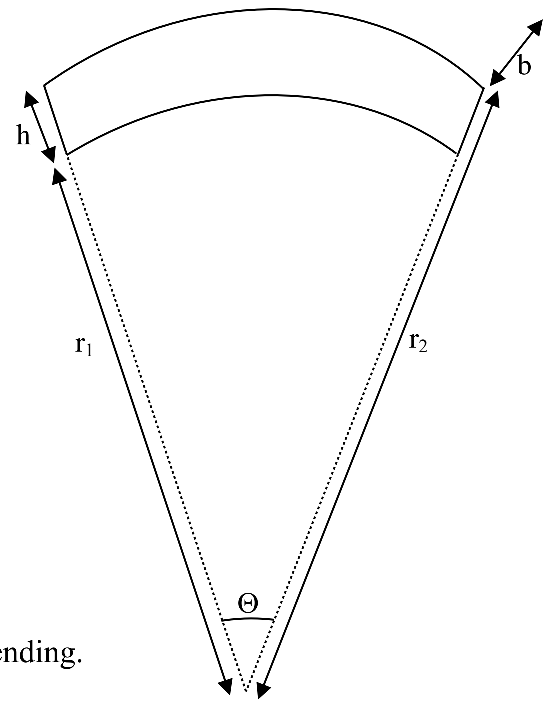


Figure S2: Real time Image of tactile sensor with pressure applied on single and multiple sensors.

Section S3. <u>Derivation of the relation between bend angle and strain produced</u>



l = length of the PET

b = breadth of the PET

h = height of the PET

r_1 = inner radius of the PET after bending

r_2 = outer radius of the PET after bending

Θ = angle of bending

The volume of the PET will remain constant before & after bending.

So equating the volume before and after bending, we get,

$l*b*h = [\Theta/360]*\pi*b*(r_2^2 - r_1^2)$

(Dividing by b on both sides),

$l*h = [\Theta/360]*\pi*(r_2^2 - r_2^2 - h^2+2r_2h)$

(Dividing by h on both sides),

$l = [\Theta/360]*\pi*(2r_2 - h)$

$\Rightarrow (360*l)/ (\Theta* \pi) = (2r_2 - h)$

$\Rightarrow r_2 = [(180*l)/ (\Theta* \pi)] + h/2$

$\therefore r_1 = [(180*l)/ (\Theta* \pi)] - h/2$

l’ = length of the outer arc of the ITO/PET after bending

ε = strain

Δl = change in length of the outer arc of the ITO/PET

$l' = [\Theta/360]*2\pi*r_2$

$\Rightarrow l' = [\Theta/360]*2\pi*[\{(180*l)/ (\Theta* \pi)\} + h/2]$

$\Rightarrow l' = l + [\Theta/360]*\pi*h$

$\therefore \Delta l = [\Theta/360]*\pi*h$

$\varepsilon = \Delta l/l$

$\Rightarrow \varepsilon = [\Theta/360]*\pi*h/l$

$\Rightarrow \varepsilon\% = [[\Theta/360]*\pi*h/l] *100$

$\therefore \varepsilon\% = [\Theta/3.6]*\pi*h/l$

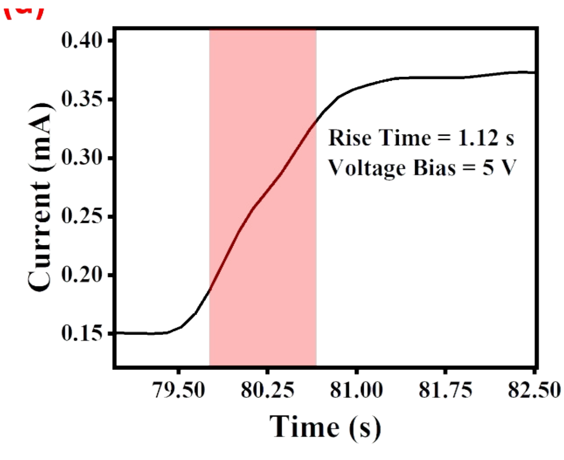


Figure S4: Response time of the strain sensor

Section S5. Humidity studies

The normalised response vs relative humidity graph is shown in figure S5, below. The normalised response was found to increase with increase in relative humidity of the sensor. This response could be attributed to the excellent surface area of MF substrate, which allows efficient absorption of the moisture and assists the rapid transfer of electrons through the C-Ppy to the Cu contacts. With the increase in relative humidity, more number of water molecules are adsorbed by the C-Ppy@MF, which aids in transferring more electrons to the contacts.

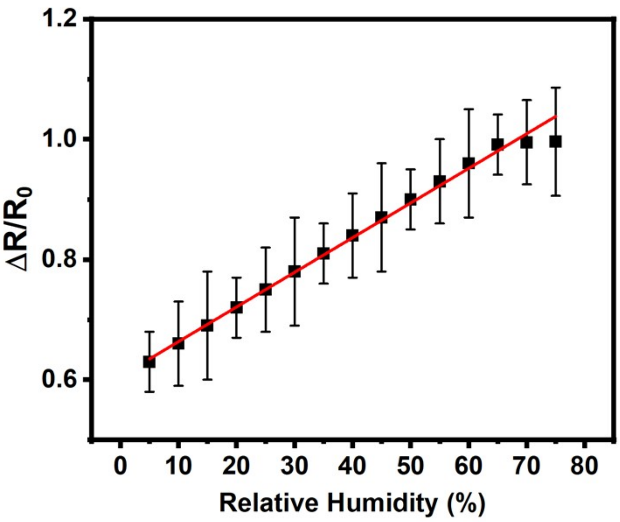


Figure S5. Normalised response vs relative humidity of the fabricated MS based breath sensor (N=4).