DEVELOPMENT OF A FLEXIBLE PIEZOELECTRIC BIOSENSOR INTEGRATING BATiO$_3$/ POLY(DIMETHYLSILOXANE) FOR POSTURE CORRECTION APPLICATIONS

Menduh Furkan Aslan[1] , Cem Özbek[1†], Gökhan Yiğit[1†], Mehmet Tosun[1†], Seda Demirel Topel[1*]

[1]Antalya Bilim University, Faculty of Engineering and Natural Sciences, Department of Electrical and Electronics Engineering, Döşemealtı, Antalya, Turkey.

•*Corresponding author: seda.demireltopel@antalya.edu.tr

•†: *the authors are equally contributed.*

INTRODUCTION & AIM

In response to the pressing issue of poor posture stemming from prolonged desk work, this study introduces an innovative solution in the form of a flexible barium titanate-poly(dimethylsiloxane) ($BaTiO_3$ /PDMS) piezoelectric biosensor. Leveraging the unique properties of $BaTiO_3$, this biosensor holds promising potential to revolutionize posture correction strategies. Our research journey encompassed not only the synthesis of the $BaTiO_3$ /PDMS composite but also involved a comprehensive analysis through various characterization techniques. We conducted COMSOL simulations, X-ray diffraction (XRD), transmission electron microscopy (TEM) analysis, and thermal evaporation to characterize the structural and functional properties of the biosensor. By integrating these diverse techniques, we gained valuable insights into the performance and behavior of the $BaTiO_3$ /PDMS composite, paving the way for further exploration and optimization of this transformative technology.

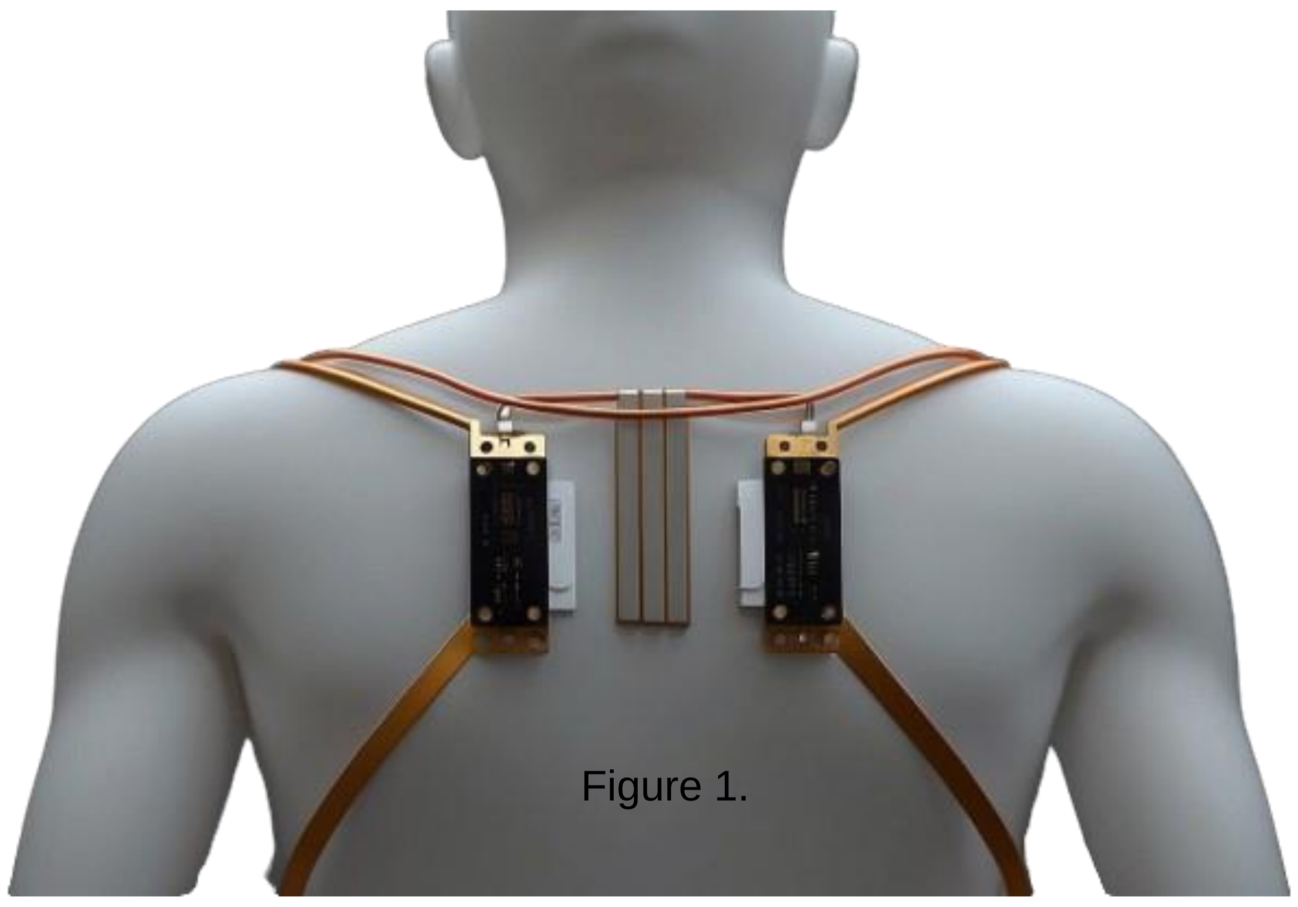


Figure 1.

METHOD

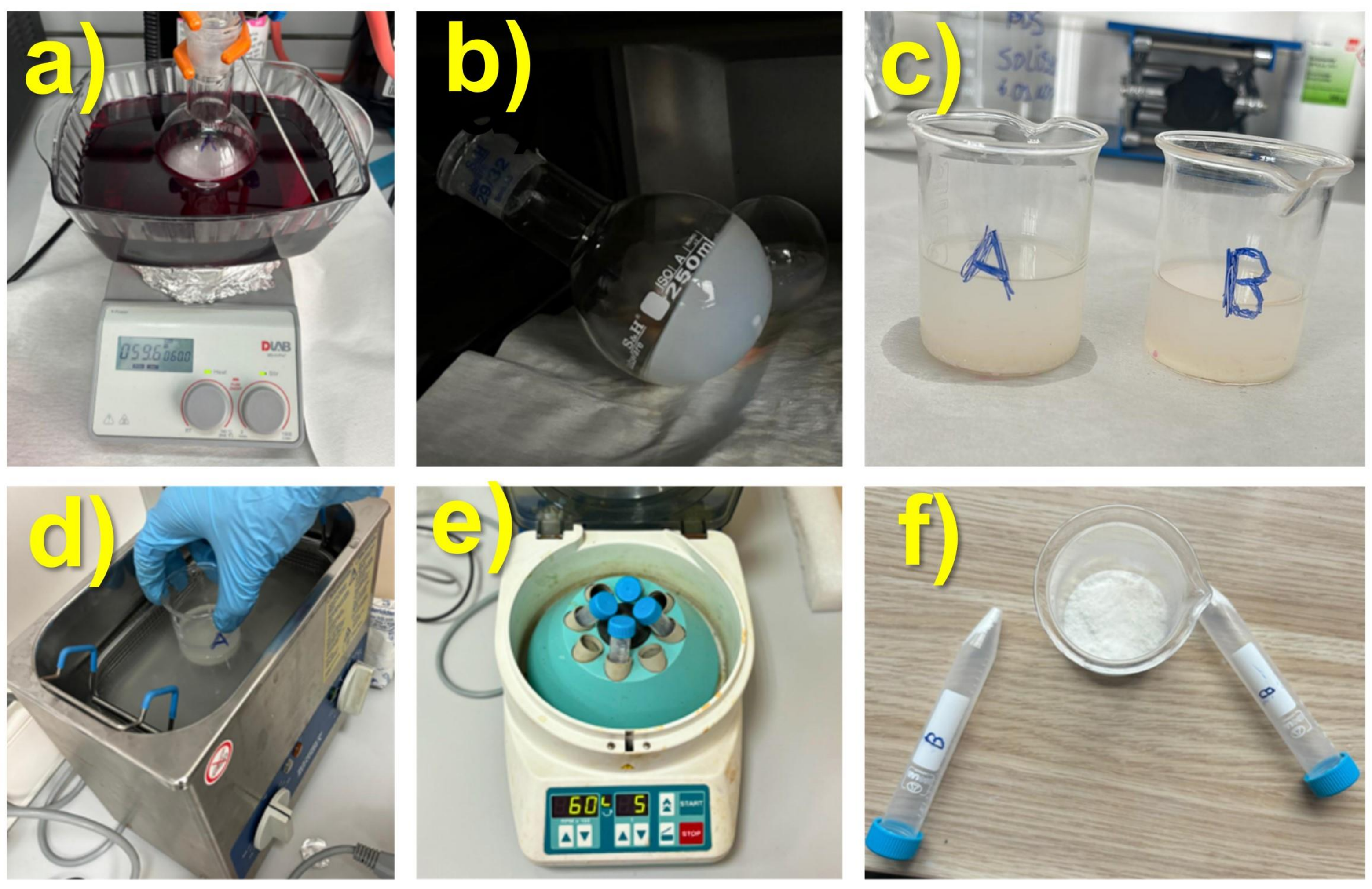


Figure 2. Preparation of the $BaTiO_3$ **a)** A blend containing barium acetate and acetic acid was stirred on a hot plate. **b)** The blend was transferred onto an oven for further processing. **c)** $BaTiO_3$ hand washed with ethanol. d) purifying the mixture with an electrolysis machine. **e)** Centrifugation aids in separation and purification. **f)** The culmination of the process yields the final product.

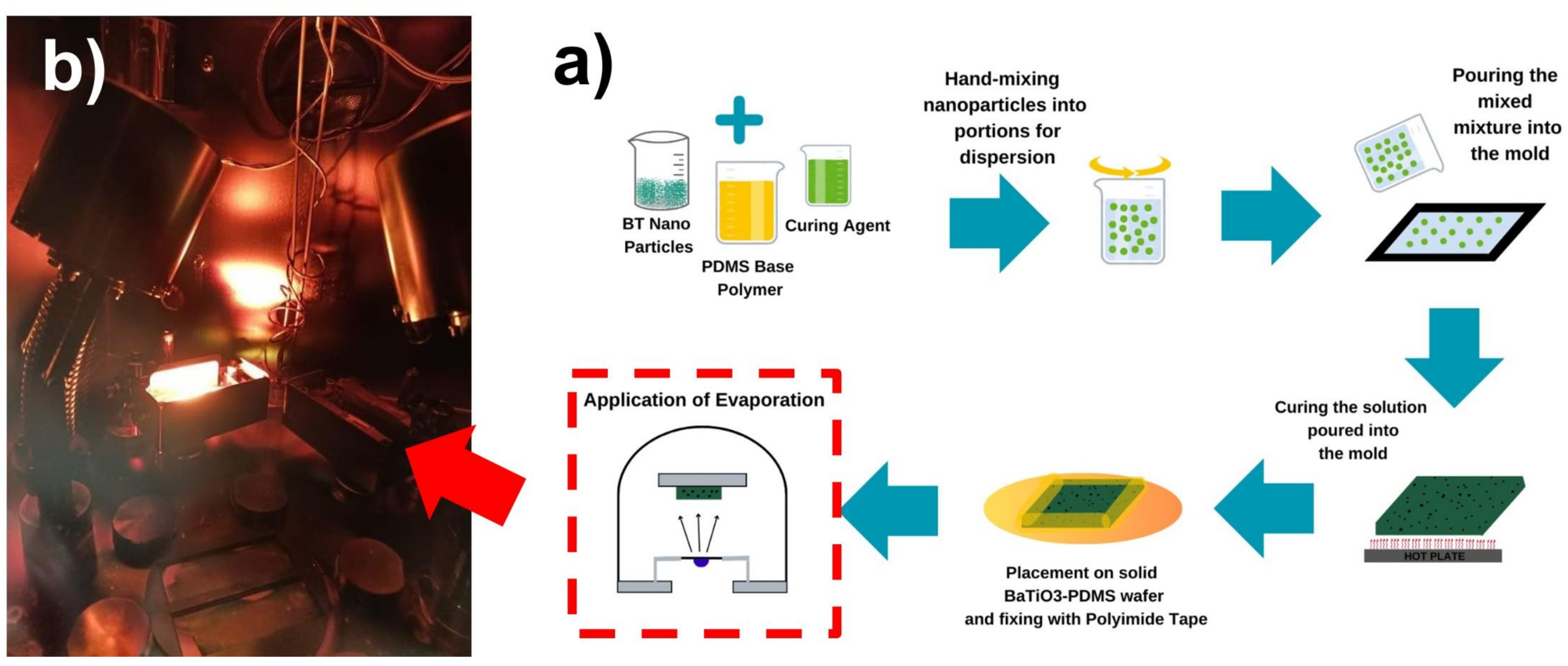
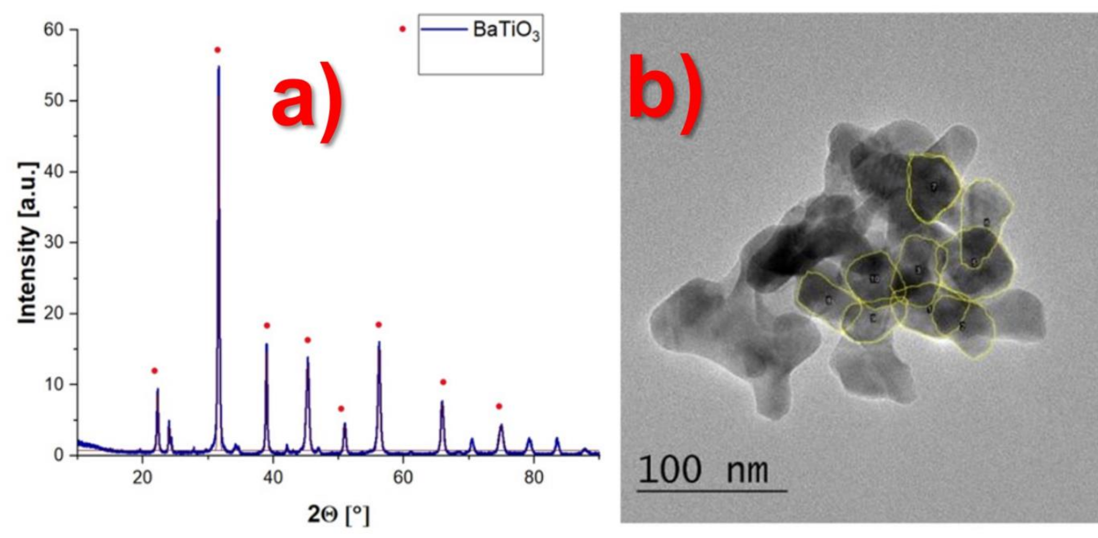


Figure 3. a) Hand-mixing Barium titanate (BT) nanoparticles with PDMS base polymer and curing agent ensures thorough dispersion, followed by pouring the mixture into a mold and curing for shape, and finally placing the cured solution onto a solid $BaTiO_3$-PDMS wafer for stability. **b)** The real-life image depicts thermal evaporation enhancing the $BaTiO_3$-PDMS composite's electrical properties, crucial for biosensor functionality.

RESULTS & DISCUSSION



c)

Label	Area	Mean	StdDev	X	Y
	48583.000	91.380	37.844	1285.913	1207.506
	40502.000	104.694	40.609	1423.163	1268.144
	44734.000	73.828	31.056	1242.776	1059.410
	41581.000	62.792	23.919	1292.265	726.002
	65995.000	90.107	33.530	1463.269	1031.724
	49439.000	112.084	42.390	1492.683	861.836
	41167.000	63.574	27.445	1294.372	727.425
	34809.000	97.093	36.638	886.266	1177.422
	33619.000	116.661	31.830	1064.316	1245.583
	37496.000	65.942	25.946	1072.459	1096.951
Mean	43792.500	87.816	33.121	1251.748	1040.200
SD	9399.350	20.270	6.246	193.716	203.575
Min	33619.000	62.792	23.919	886.266	726.002
Max	65995.000	116.661	42.390	1492.683	1268.144

Figure 4. a) X-ray diffraction peaks of $BaTiO_3$ b) TEM analysis image showcases selected $BaTiO_3$ particles for measurement c) Measurement of selected $BaTiO_3$ particles includes calculation of mean and standard deviation, crucial for characterization.

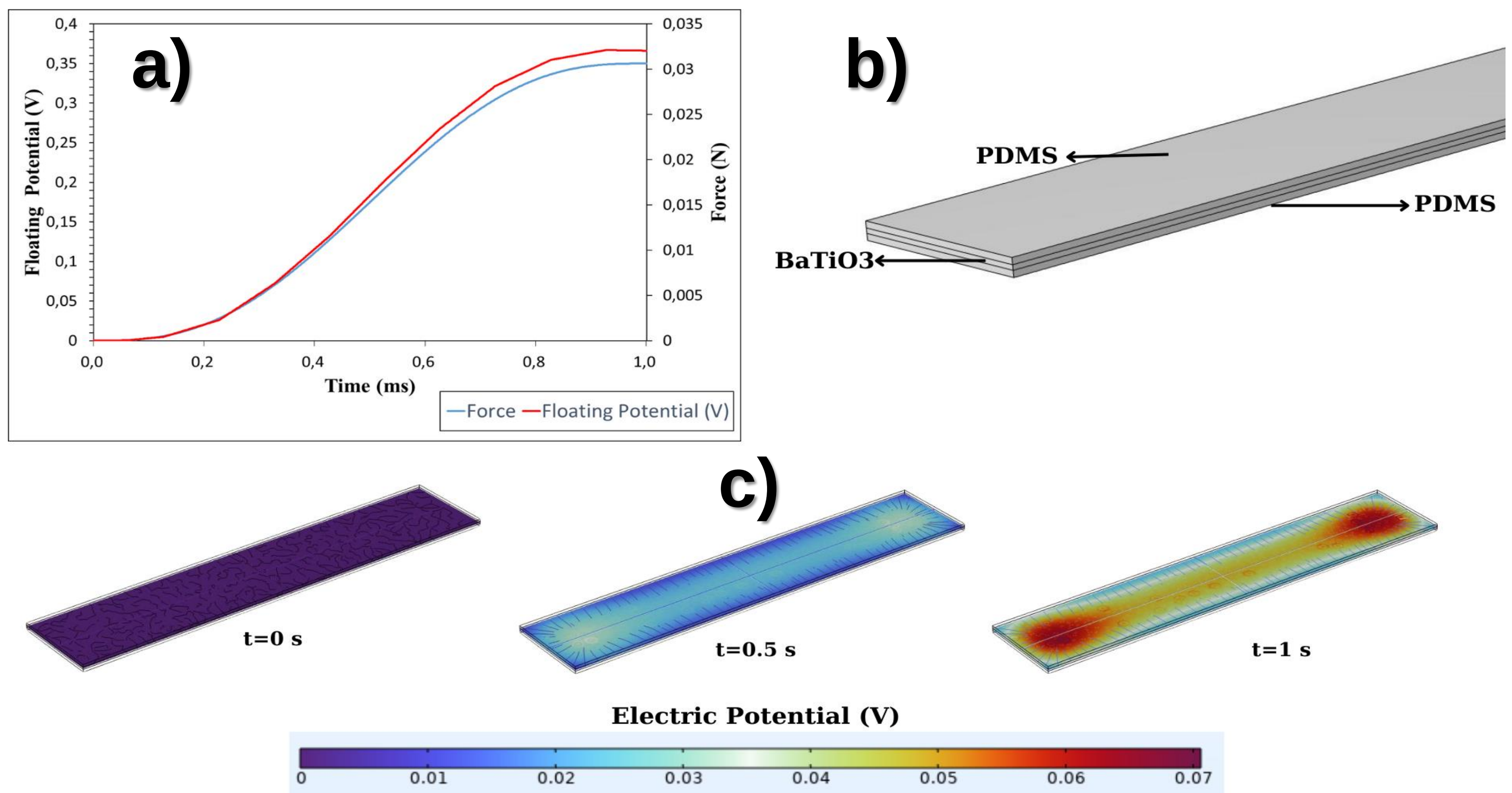


Figure 5. a) Time-Dependent Floating Potential vs. Force (N) Graph **b)** Component Design in COMSOL Simulation **c)** Temporal Evolution of Sensor Image

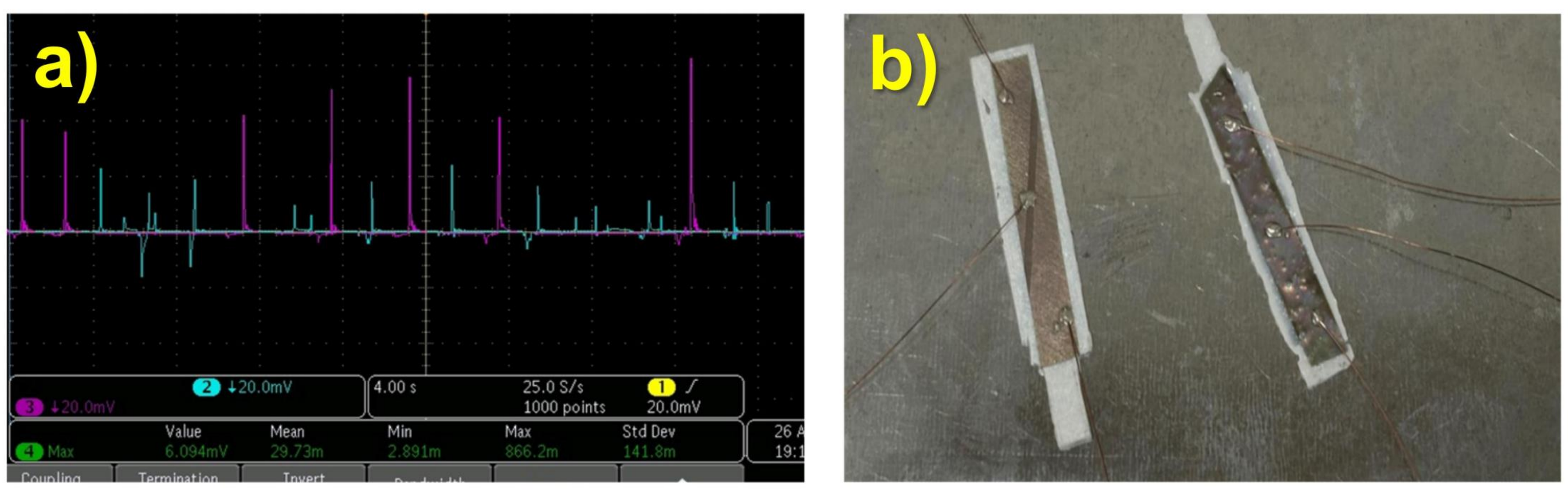


Figure 6. a) The oscilloscope plot illustrates the output voltages of sensors, with purple lines denoting 35 wt% $BaTiO_3$ and blue lines representing 30 wt% $BaTiO_3$ sensors. **b)** The sensors image showcases the innovative Barium titanate-poly(dimethylsiloxane) $BaTiO_3$ /PDMS) piezoelectric biosensor, highlighting its potential in addressing posture-related challenges associated with extended desk work. They elucidate the biosensor's structure, operation, and the coating process via thermal evaporation, enhancing its functionality. This layer underscores the biosensor's versatility and effectiveness in addressing poor posture.

CONCLUSION

In conclusion, the synthesis process involving spinning, oven placement, hand mixing, electrolysis, centrifugation, and purification yields high-quality $BaTiO_3$ nanoparticles. These nanoparticles hold significant potential for diverse applications in electronics, sensors, and energy storage devices, thereby driving advancements in nanomaterial synthesis and utilization.

ACKNOWLEDGE

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