Supplementary Materials: Versatile Flexible Graphene Multielectrode Arrays

Dmitry Kireev, Silke Seyock, Mathis Ernst, Vanessa Maybeck, Bernhard Wolfrum and Andreas Offenhäusser

Table S1. Comparison of the signal-to-noise ratio (SNR) of the extracellular recording with different kinds of microelectrode arrays (MEAs).

	Active Material	Substrate	Electrode Diameter	Tissue Type	SNR
This work	Graphene	Polyimide	20 µm	Heart tissue HL-1	65 ± 15 [(a)] 20 ± 10[(a)]
Du et al. [1]	Graphene	Polyimide	20 µm	Neurons	10.3 ± 1.2
Brüggemann et al. [2]	Au planar	SiO2/Si	10 µm 20 µm	HL-1	57 [(b)] 141 [(b)]
Hofmann et al. [3]	Au nanocavity	SiO2/Si	10 µm	HL-1	158 ± 8
Nick et al. [4]	Au Rough TiN	Quartz	30 µm	Chicken cardiomyocytes	10 [(c)] 207 [(c)]
James et al. [5]	Au planar Pt nonplanar	Fused silica	12 µm	Neurons	15 ± 10

(a) Noise defined as 2*MAD (mean absolute deviation); (b) Noise defined as root mean square (RMS); (c) SNR defined as variance ($(v_{peak}/\sigma_{noise})^2$).

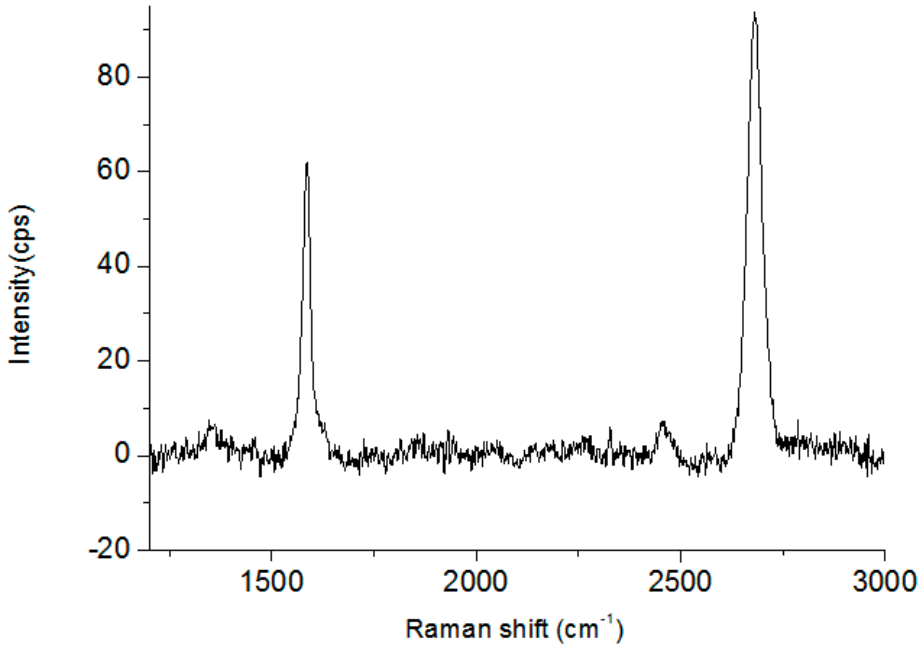

Figure S1. Raman spectra of the chemical vapor deposition (CVD)-grown graphene used. Almost-absent D peak shows that the graphene is without defects.

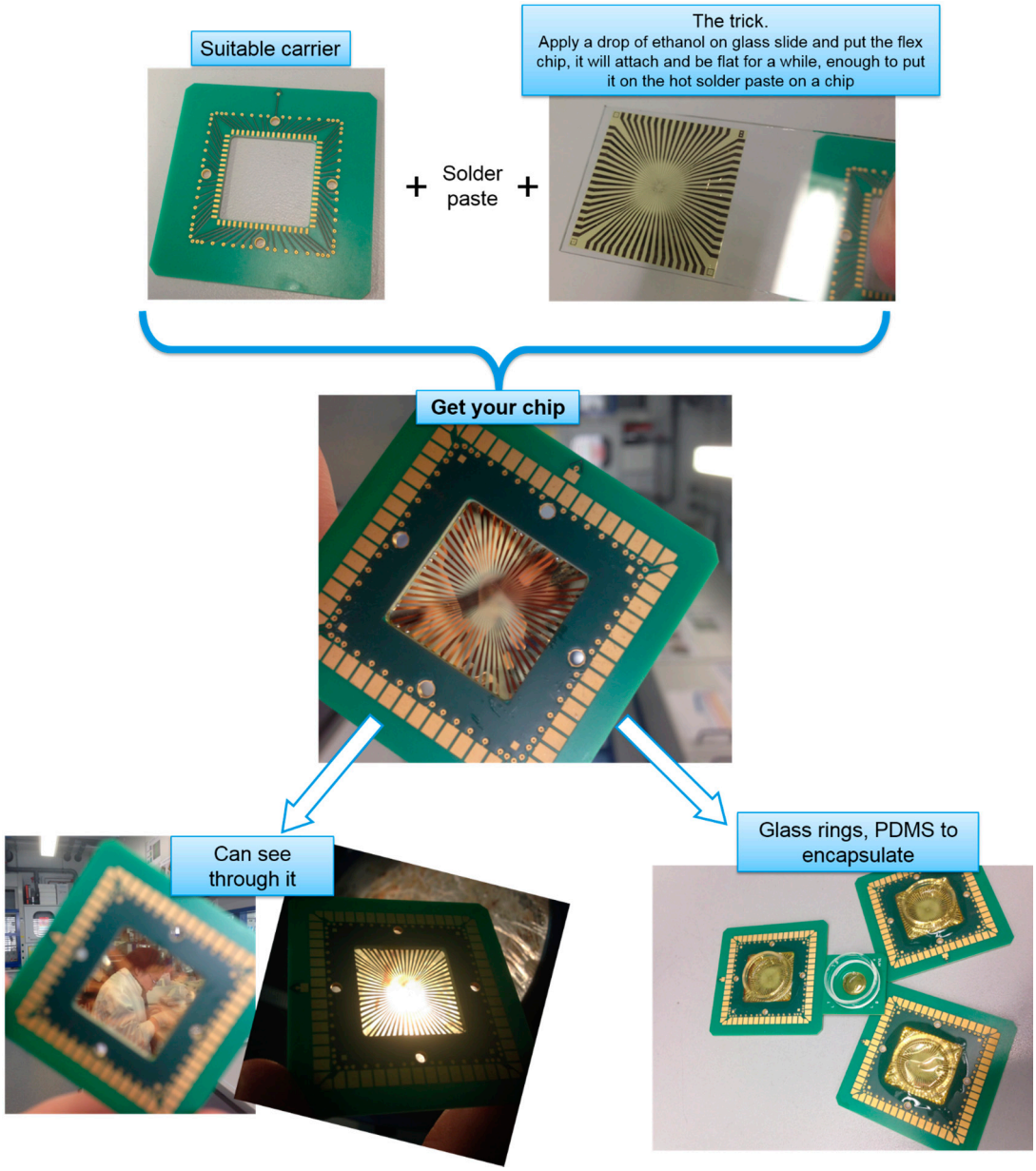

Figure S2. Soldering flexible chip: overview.

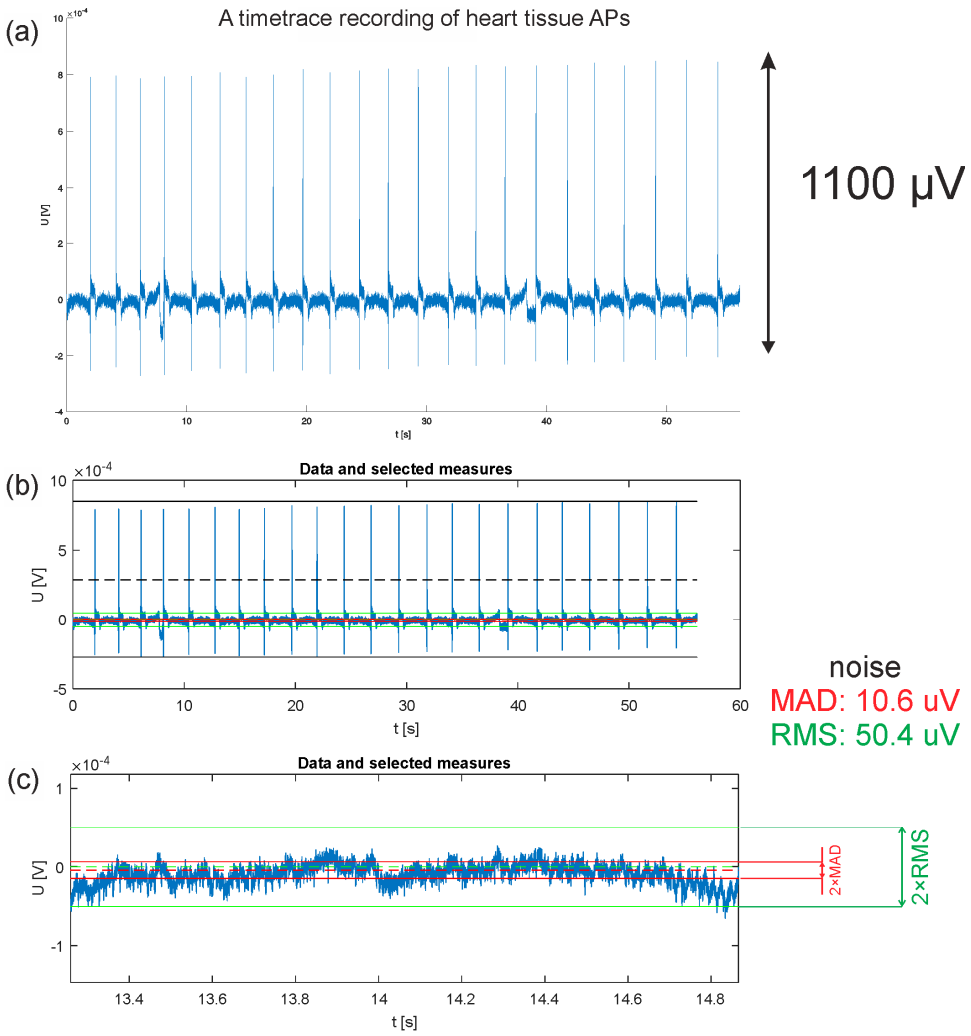

Figure S3. MAD vs RMS noise value comparison. For a long recording, the noise is usually evaluated for the whole time (**a**,**b**). In this case, the RMS value will be overestimated, while the 2*MAD value better approximates the peak-to-peak noise in the interspike interval, as can be seen in (**c**).

References

1. Du, X.; Wu, L.; Cheng, J.; Huang, S.; Cai, Q.; Jin, Q.; Zhao, J. Graphene microelectrode arrays for neural activity detection. *J. Biol. Phys.* **2015**, *41*, 339–347.
2. Brüggemann, D.; Wolfrum, B.; Maybeck, V.; Mourzina, Y.; Jansen, M.; Offenhäusser, A. Nanostructured gold microelectrodes for extracellular recording from electrogenic cells. *Nanotechnology* **2011**, *22*, 265104.
3. Hofmann, B.; Kätelhön, E.; Schottdorf, M.; Offenhäusser, A.; Wolfrum, B. Nanocavity electrode array for recording from electrogenic cells. *Lab Chip* **2011**, *11*, 1054–1058.
4. Nick, C.; Joshi, R.; Schneider, J.J.; Thielemann, C. Three-dimensional carbon nanotube electrodes for extracellular recording of cardiac myocytes *Biointerphases* **2012**, *7*, 1–6.
5. James, C.D.; Spence, A.J.H.; Dowell-Mesfin, N.M.; Hussain, R.J.; Smith, K.L.; Craighead, H.G.; Isaacson, M.S.; Shain, W. Turner, J.N. Extracellular recordings from patterned neuronal networks using planar microelectrode arrays *IEEE Trans. Biomed. Eng.* **2004**, *51*, 1640–1648.