Electronic Supplementary Material (ESI) for Biomaterials Science.

Supporting Information

Theranostic microneedle array patch for integrated glycemia sensing and self-regulated release of insulin

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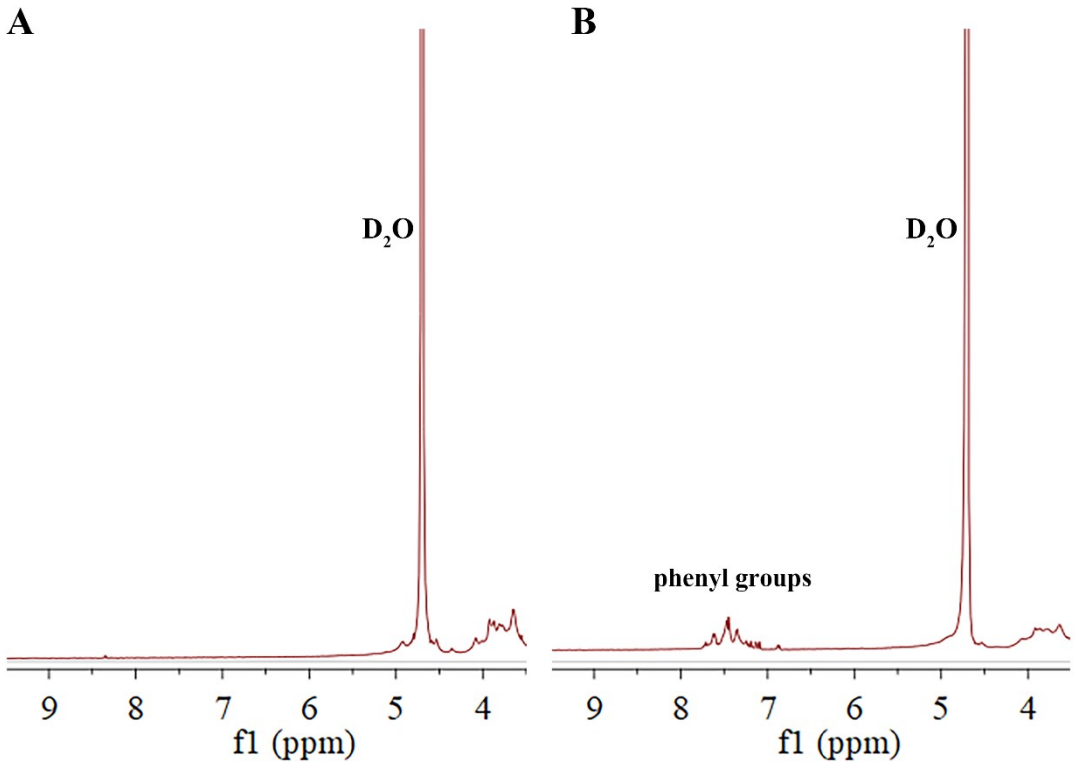
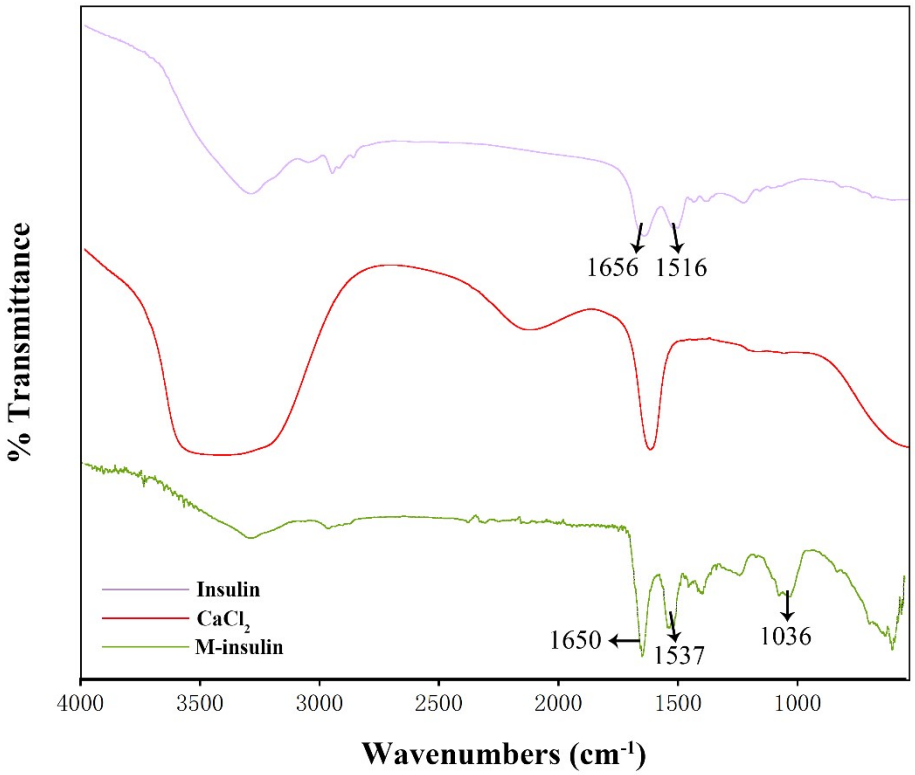
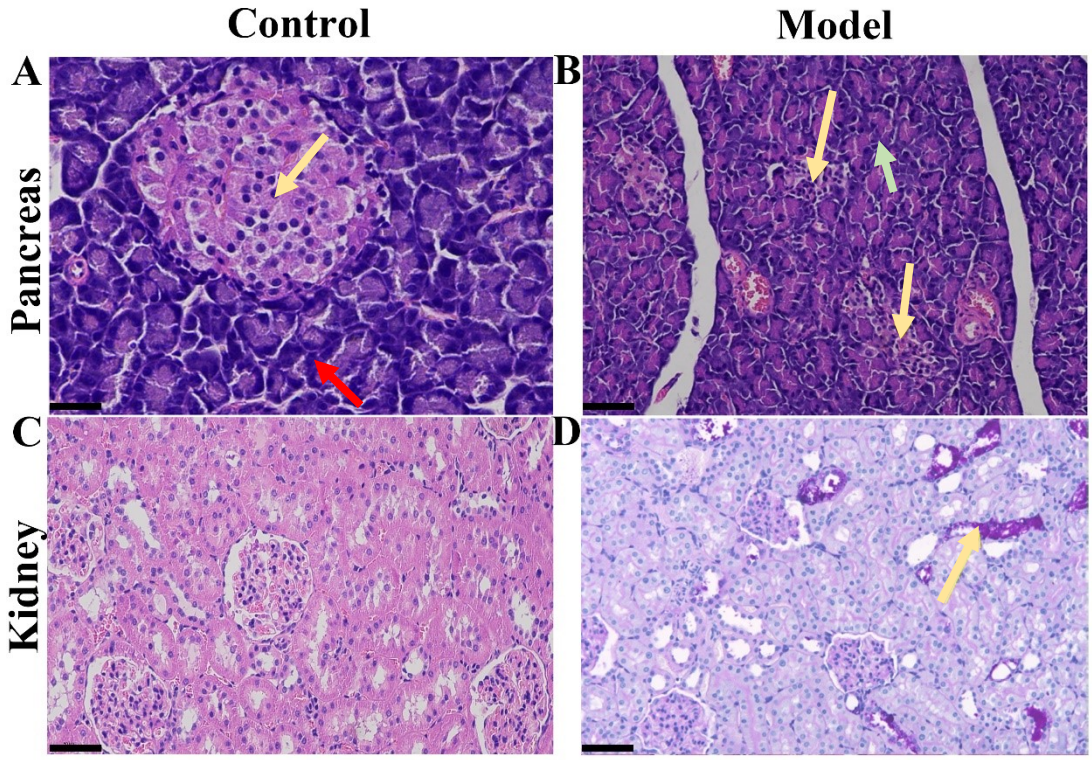


Supplementary Fig. 1 ^{1}H NMR spectra of Alg (A) and Alg-ABA (B).



Supplementary Fig. 2 FTIR spectra of calcium chloride, insulin and M-insulin.



Supplementary Fig. 3 Presentation of histological examination of rats in normal control group and model group. A) Pancreas H&E stained section of the control group. The overall structure of pancreatic tissue is basically normal, and the distribution of islet cells in the tissue is regular. As shown by the yellow arrow, pancreatic islet B cells are located in the center of the pancreatic islets. There is no obvious degeneration such as vacuolar degeneration, proliferation, necrosis, etc. in the tissue islet cells. The red arrow shows the zymogen granules of acinar epithelial cells, and there is no obvious inflammatory cell infiltration in the tissue. **B)** Pancreas H&E stained section of the model group: the overall structure of the pancreas is abnormal, the shape of the islets is irregular, the distribution of islet cells is disordered. As shown by the yellow arrow, a large number of islets are obviously atrophy in the tissue. The green arrow shows the pancreatic acinar vertebral cells. **C)** Kidney of the control group. **D)** Kidney PAS stained sections of the model group: the overall structure of the kidney tissue is slightly abnormal, as shown by the yellow arrow, a large amount of glycogen accumulation in the renal tubules.

Supplementary Table 1 Comparison of different hydrogel microneedles for glycemia control time.

Hydrogel microneedles	Acting time	Ref.
A triblock copolymer including poly (ethylene glycol), poly (phenylboronic acid) and poly (phenylboronic acid pinacol ester)	4.0h	[1]
Two-layer dissolving polymeric microneedle patches	2.6h	[2]
Multilayered pyramidal dissolving microneedle patches with flexible pedestals	1.0h	[3]
A hierarchically structured microneedle patch (MNDF)	4.2h	This work

Reference

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2. I. C. Lee, W.-M. Lin, J.-C. Shu, S.-W. Tsai, C.-H. Chen and M.-T. Tsai, *Journal of Biomedical Materials Research Part A*, 2017, **105**, 84-93.
3. S. Y. Lau, J. Fei, H. R. Liu, W. X. Chen and R. Liu, *Journal of Controlled Release*, 2017, **265**, 113-119.