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Inkjet 3D bioprinting for tissue engineering and pharmaceutics

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Inkjet Printing Technologies

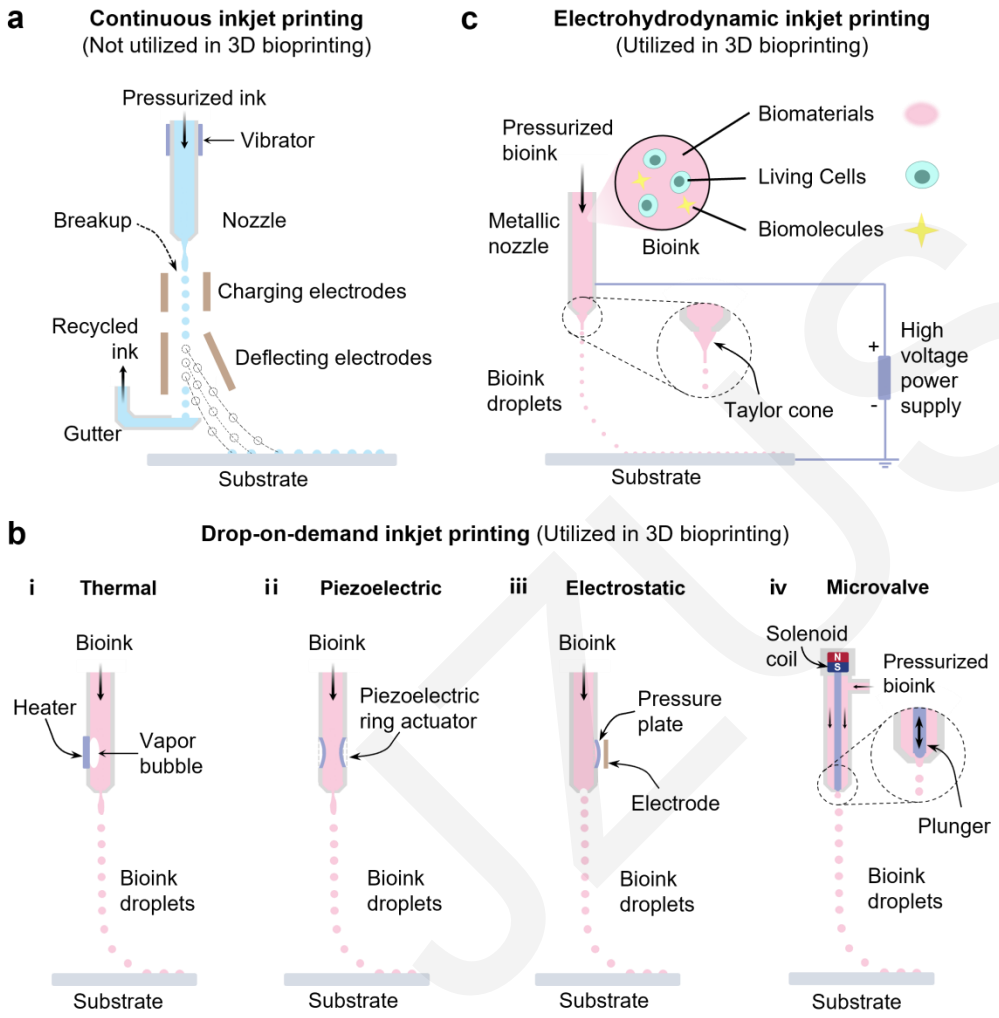


Fig. 1 Depiction of typical inkjet printing technologies: (a) CIJ printing, (b) DOD inkjet 3D bioprinting: (i) TIJ 3D bioprinting, (ii) PIJ 3D bioprinting, (iii) electrostatic inkjet 3D bioprinting, and (iv) microvalve inkjet 3D bioprinting, and (c) EHD inkjet 3D bioprinting

In vitro tissue models

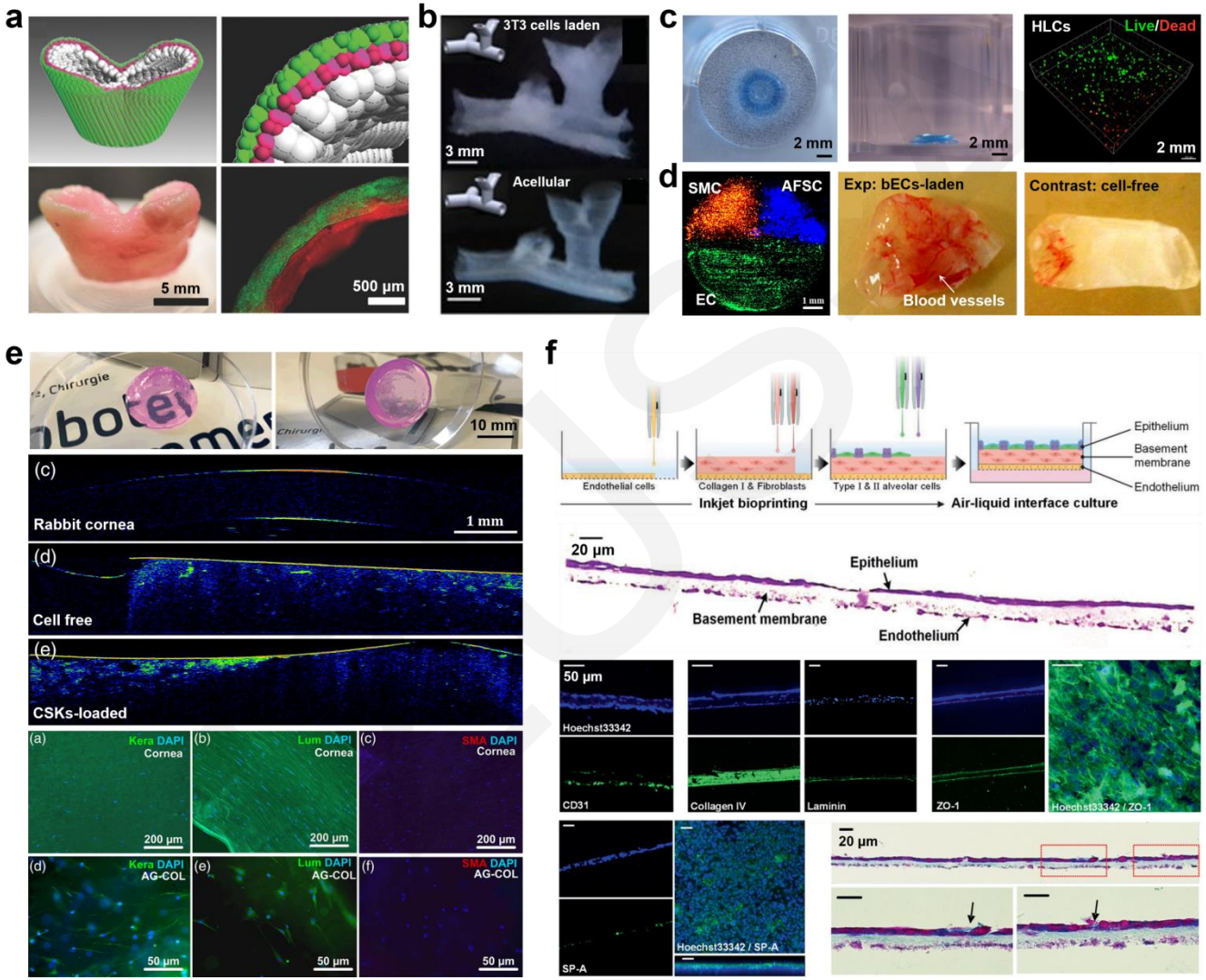


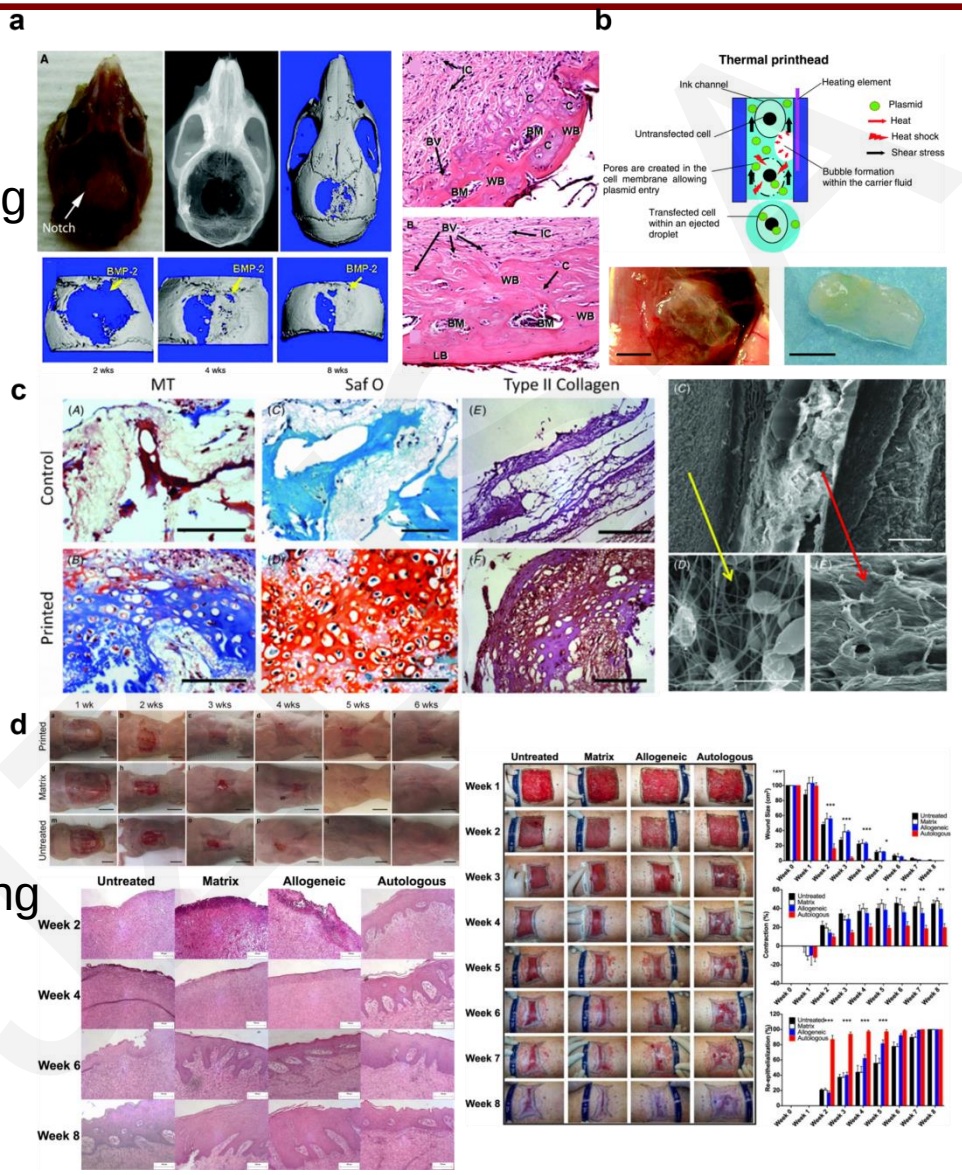
Fig. 2 Inkjet 3D bioprinting of in vitro biomimetic 3D tissue structures

In vivo tissue substitutes

Engineered bones guiding cell differentiation in vivo

Cartilage-like constructs

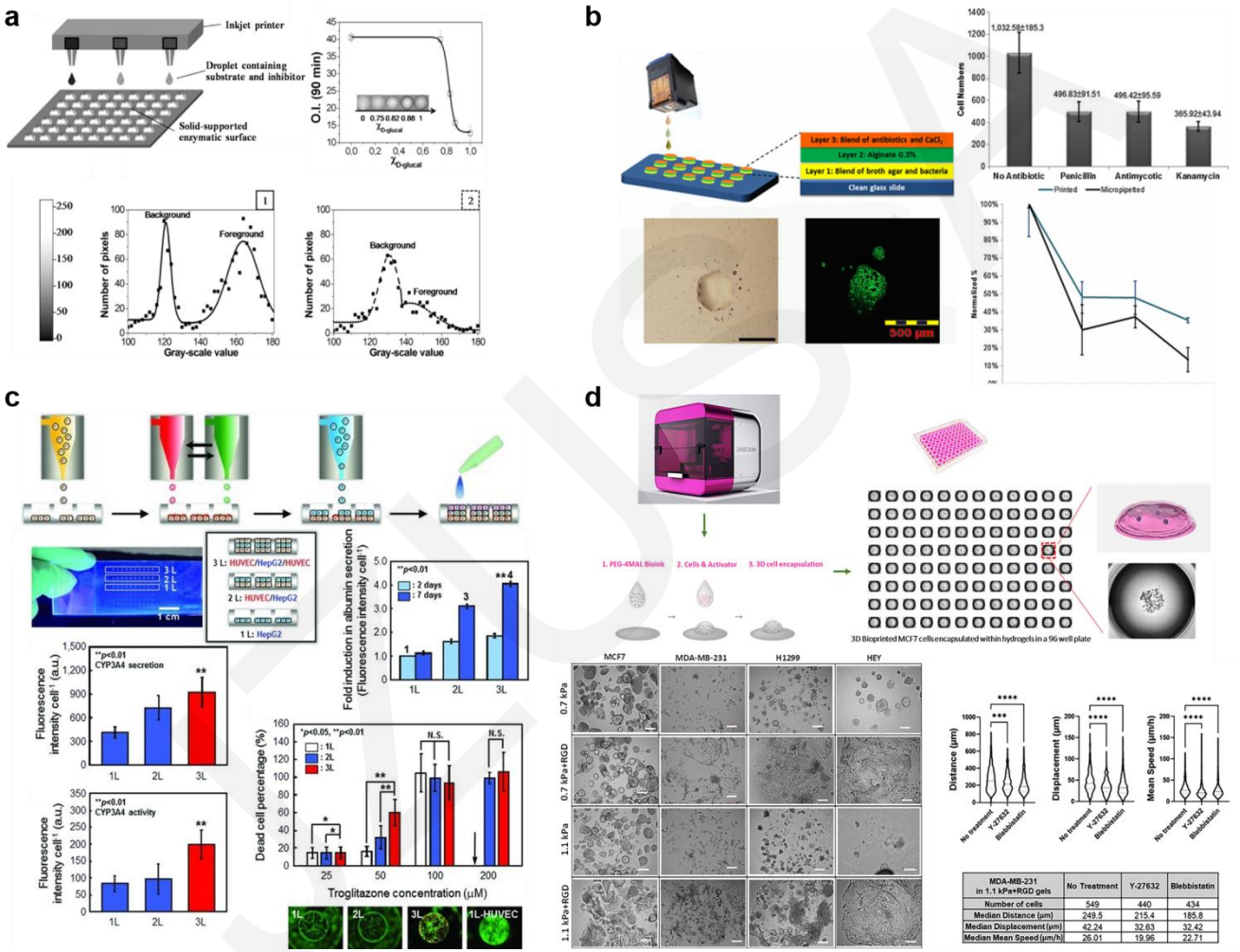
Engineered skin facilitating skin wound closure



Printed tube with vasculature

Fig. 3 In vivo tissue substitutes using inkjet 3D bioprinting

Drug Screening



MDA-MB-231 in 1.1 kPa+RGD gels	No Treatment	Y-27632	Blebbistatin
Number of cells	549	440	434
Median Distance (μm)	249.5	215.4	185.8
Median Displacement (μm)	42.24	32.63	32.42
Median Mean Speed (μm/h)	26.01	19.96	22.71

Fig. 4 Applications of inkjet 3D bioprinting in drug screening

Conclusions

- This review focusing on inkjet 3D bioprinting firstly summarizes the techniques, materials, and applications of inkjet 3D bioprinting, subsequently discusses the major challenges that inkjet 3D bioprinting is currently facing, and lastly proposes potential solutions for addressing those challenges.

- Inkjet 3D bioprinting has proved its feasibility and versatility in tissue engineering and pharmaceutics. However, inkjet 3D bioprinting still needs significant improvements in several aspects, such as its printing resolution and speed. In addition, the materials which are suitable for inkjet 3D bioprinting are still quite limited.

- Interdisciplinary collaboration between experts from engineering, materials science, biology, and clinic is necessary to promote the development of inkjet 3D bioprinting. Moreover, inkjet 3D bioprinting, combined with other printing techniques and relying on multi-method to 3D bioprint multi-material and multi-cell, will be the future trend and lead inkjet 3D bioprinting of 3D engineered tissues and organs to the clinical translation.