

# Autoadhesive conductive cryogel as an electrode for electrical stimulation to promote skin wound healing

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## Introduction

Transcutaneous or transdermal electrical stimulation is the technique that uses electrical field to noninvasively stimulate muscle or nerve through multiple electrodes patched to the skin<sup>1</sup>. Existing devices include transcutaneous electrical nerve stimulation (TENS)<sup>2</sup>. The electrodes used by these devices are made of metal, carbon- or graphene-filled silicone, or self-adhesive gel<sup>3</sup>. They are all in the form of small pads and are not suitable for surrounding a skin wound with an irregular form. Applying these pads to the skin also requires undesirable pressure for sensitive skin.<sup>4,5</sup>

## Objective

To develop a conductive gel that is auto-adhesive (i.e., no pressure needed), compliant to different contours, and easily tailored into different shapes to surround a wound (Fig. 1A).

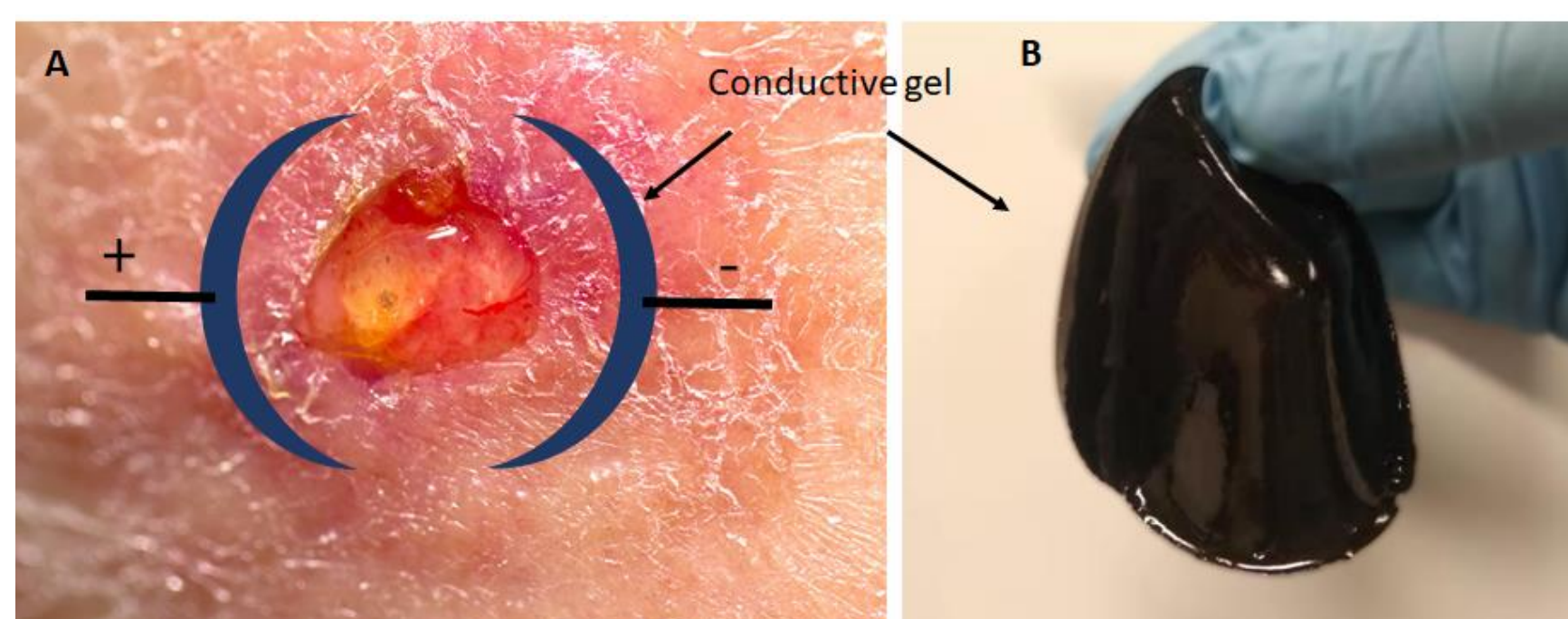


Figure 1. A: Illustration of how to electrically stimulate a skin ulcer; B: The conductive cryogel.

## Methods

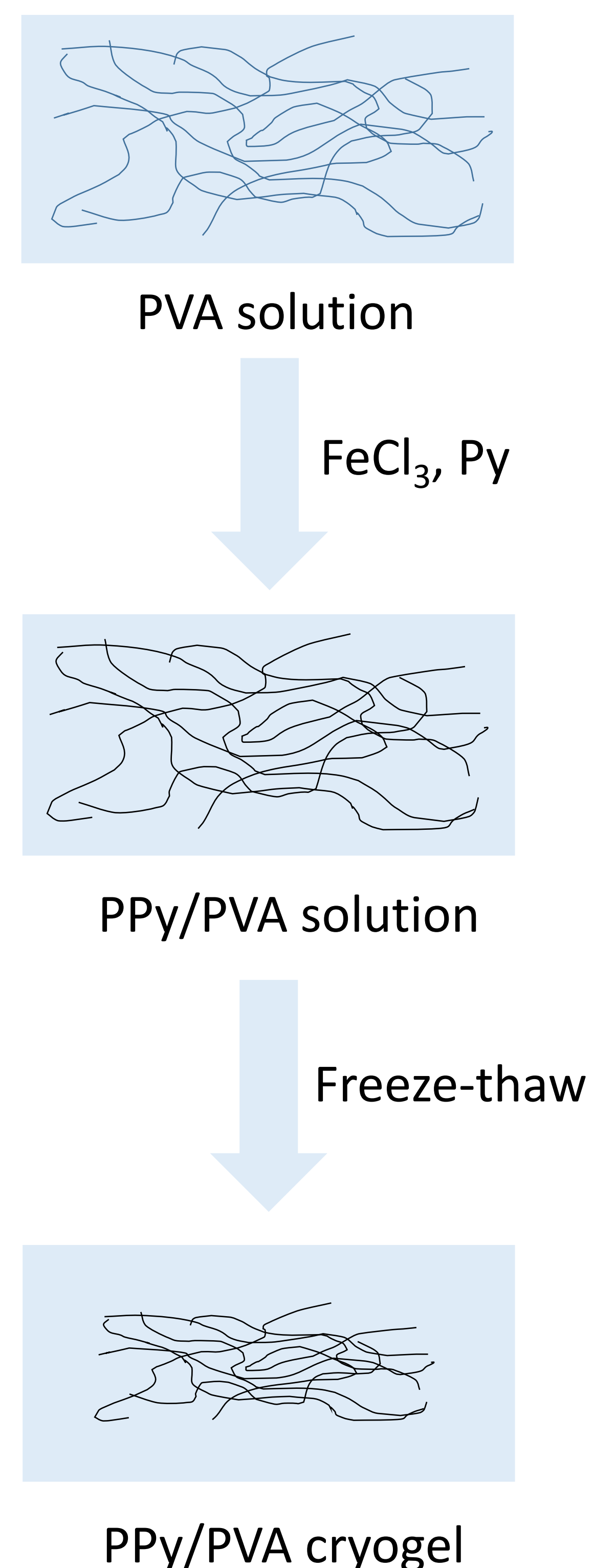


Figure 2. Preparation scheme of Polypyrrole/Polyvinyl alcohol (PPy/PVA) cryogel.

**I:** The prepared cryogel was a soft hydrogel (Fig. 1B) with an electrical conductivity adjustable from 10<sup>-4</sup> S/cm - to above 1.0 S/cm depending on the amount of PPy.

**II:** The as-prepared gel can be easily put on the skin, offering close contact without applying any force. This process can be repeated without losing the auto-adhesion ability. (Fig. 3)

**III:** After freeze-drying, the dehydrated membrane became rigid. However, it regained its original flexible property when it was put back into the water. The swelling water ratio was 1:1.79 to 1:1.96

## Results

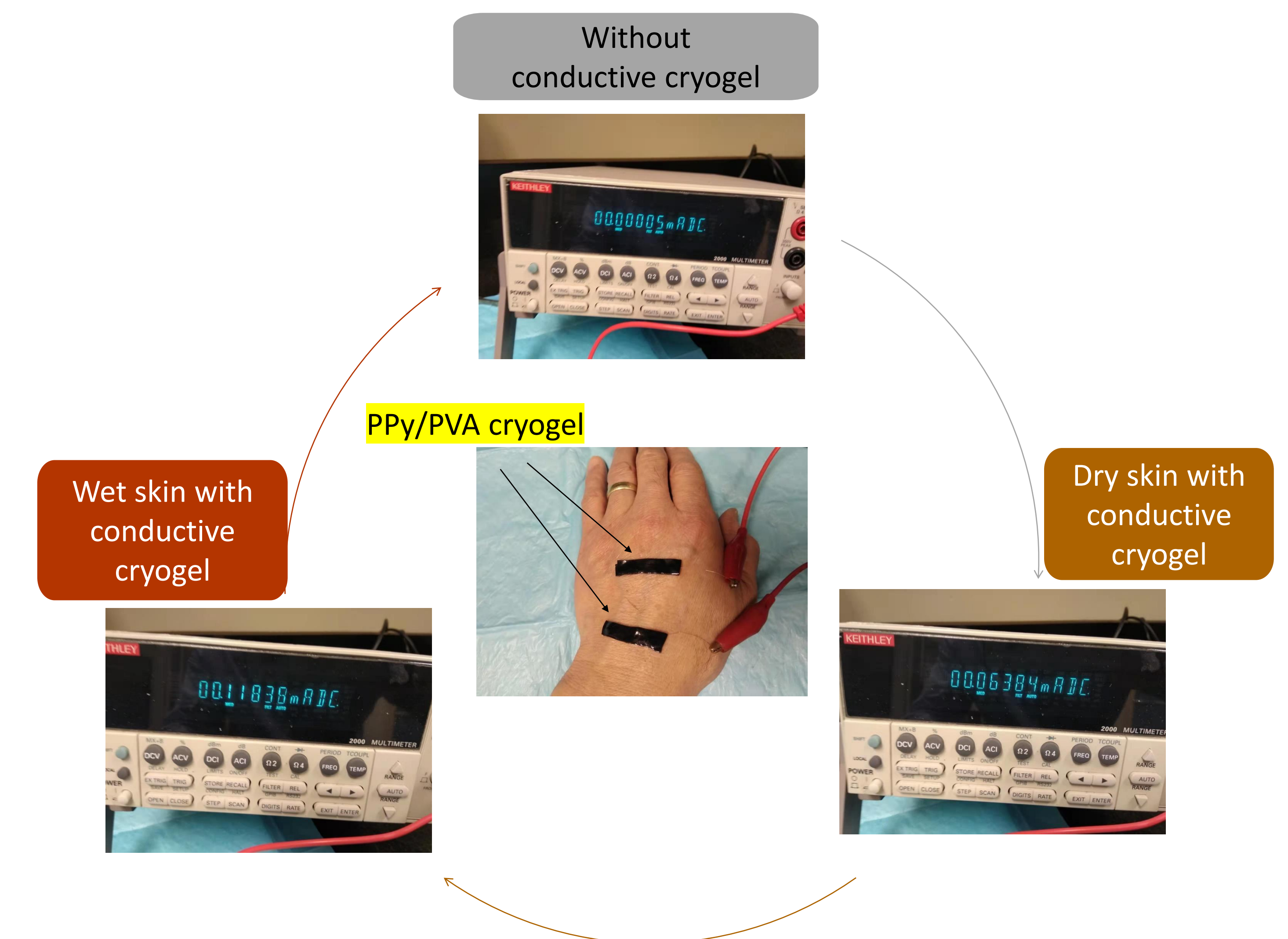


Figure 3. A: Demonstration of how to electrically stimulate a skin through: the PPy/PVA cryogel.

## Conclusions

We prepared a conductive cryogel that has an auto-adhesive ability to the skin. The gel was soft and compliant with the contour of the skin. This conductive gel may be used as an electrode to apply electrical stimulation to skin wounds.

## Acknowledgements

## References

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