**Soy Protein-based Soft Gels for Sensors and Soft Robotics**

**-Executive Summary-**

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Soft and stretchable conductive hydrogels have attracted a lot of attention for their promising applications in the fields of artificial intelligence, soft robotics, and wearable devices. However, most existing conductive hydrogels suffer from the limitations of low mechanical robustness, low stretchability, and vulnerability to drying and freezing, which hinder their durability and application areas/environments in real life. Moreover, most of the existing hydrogels are made from non-renewable materials.

In this project, we developed a soy protein-based hydrogel that is strong, highly stretchable, conductive, and freezing and drying resistant. The strength and flexibility of the new hydrogels are attributed to the double network structure inside the material formed by the soy protein molecules and another polymer. Additives including a salt, low-temperature plasticizer, and a natural fibrous material were incorporated into the hydrogel formulation to offer them the other desirable properties. The formulation was meticulously investigated, and the key ingredients and their contents were identified. The hydrogels with properties suitable for a scope of different applications can therefore be produced by adjusting the formulation.

The flexibility and stretchability of the hydrogels even under very low temperatures (up to −70 °C) are demonstrated in Figure 1, where they are bent and stretched without fracture. At the same time, the conductivity of the hydrogels under these low temperatures is still high enough to lighten up LEDs (Figure 2). The properties exhibited by these new gels make them ideal materials for making wearable sensors and soft robotics. Further development can be pursued to enable industrial applications.