Hydrogels are soft materials that are full of water, making them useful for a wide variety of applications including cell culture, tissue engineering, drug delivery, and even agriculture. [**Click**] A hydrogel is formed when long, hydrophilic polymer chains are bound to each other in a process called crosslinking. [**Click**] If it has the right physical, chemical, and mechanical properties, this entangled polymer network can hold cells in its pores and be extruded through a 3D printing nozzle or injected with a syringe. [**Click**]

However, it can be challenging to form a hydrogel with the right properties. The type and concentration of each polymer and crosslinking additive as well as the crosslinking conditions all affect the hydrogel’s properties and therefore its applications. Companies such as Sigma-Aldrich take advantage of this difficulty by selling hydrogels with custom stiffness to be used for different cell tissues. We believe the complex relationship between the hydrogel formulation parameters and its properties can be efficiently determined using Bayesian Optimization in the context of a self-driving lab. [**Click**]

However, a self-driving lab for hydrogels requires automated processing and characterization. Hydrogels are soft and difficult to handle, and the traditional methods to characterize their properties, such as rheometry and video-particle tracking, are not highly amenable to automation. [**Click**] We propose using dynamic light scattering, or DLS, which can not only detect gelation but also determine the viscoelastic properties of the gels up to a stiffness of about 10 kPa. [**Click**]

The workflow for this self-driving lab is as follows: The hydrogel formulations are mixed in a 96-well plate using an open-source liquid-handling robot such as an OpenTrons. [**Click**] Next, the gels are crosslinked with either an LED array, a heating module, or simply with time. [**Click**] Their gelation and viscoelastic properties are then measured using a DLS plate reader, specifically designed for 96-well plates. [**Click**] The resulting properties are analyzed and [**Click**] sent to a Bayesian Optimizer to determine what formulations and processing parameters to try next. [**Click**]

In the end, you can make a hydrogel formulation with your desired chemical components that also has your desired properties, such as amenability to 3D printing, injection, or cell culture. [**Click**] This will be a game changer for biological research by rapidly increasing the availability and reliability of data, [**Click**] optimizing our future for health and well-being.

Thank You.

[End]