It is well known that polyvinyl alcohol (PVA) forms hydrogels in aqueous solution, and its application in the field of biomaterials has long been anticipated. To achieve sufficient mechanical strength, a variety of preparation methods—such as repeated freeze-thaw cycles—have been proposed. The PVA/polyacrylamide (PAAm) double network (DN) hydrogel is one such method. However, DN gels are sometimes not sufficiently transparent due to the preparation process, which limits their application.

In this study, we developed a new and simple process for preparing PVA/PAAm DN hydrogels with improved transparency and mechanical strength. The DN gel was synthesized using finely crushed low–degree of polymerization (low-DP) PVA as the first network and PAAm as the second.

To obtain the first gel, low-DP PVA was dissolved in a heated DMSO/water solvent and then cooled at −40 °C for 24 hours. The resulting gel was finely ground with a mortar and pestle while mixing with an acrylamide (AAm) solution containing the polymerization initiator 2-oxoglutaric acid (OA) and the crosslinker N,N′-methylenebisacrylamide (MBAA). This mixture was poured into a cubic mold (25 mm per side) made of slide glass, and ultraviolet (UV) irradiation was applied to initiate the radical polymerization of AAm.

Through this process, a transparent and elastic PVA/PAAm DN hydrogel was obtained. The Young's modulus of the resulting gel fell within the general range for human blood vessels. Furthermore, its transparency may allow for the measurement of stress interactions between blood flow and vessel walls using photoelasticity.