

THE CREATION OF POROUS HYDROGELS USING PEROXIDES

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Polymer hydrogels are hydrophilic structured systems that swell well but are insoluble in water. Typically, they are obtained by polymerising water-soluble unsaturated compounds in the presence of a bifunctional cross-linking agent or by cross-linking pre-prepared polymers. Hydrogels are widely used as drug delivery devices, immobilised biologically active compound carriers, and implants. In recent years, hydrogels with nano-, micro-, and macroporous structures have been researched and synthesised. They have been widely used in tissue engineering, for protein separation, and purification. A significant disadvantage of known hydrogels, in particular porous hydrogels, is their low physical and mechanical characteristics.

The main purpose of the research was to improve the mechanical properties of a porous gel by chemically reinforcing the pore walls. The imparting of adjustable physical and mechanical properties to porous hydrogels was achieved by using a filler with a specifically modified surface. This process includes the following steps: 1. Peroxidation of the silica surface by adsorption of heterofunctional polyperoxide; 2. Grafting polyacrylamide chains to the peroxidised surface; 3. Formation of a three-dimensional gel network using a filler with a reactive surface; 4. Creation of a porous system by removing the mineral component of the filler.

Peroxidation of the mineral filler surface with a subsequent graft polymerisation from the acrylamide surface makes it possible to obtain silica particles containing grafted polyacrylamide chains on the surface. The use of modified silica as a reactive filler in the formation of hydrogels leads to the establishing of a three-dimensional mesh with the involvement of grafted polyacrylamide chains in it.

The grafting of polyacrylamide to the surface of silica was confirmed by FTIR multiple reflection spectroscopy and thermogravimetric analysis.

Thus, when using the modified filler, a more uniform distribution of the filler in the polymer matrix was observed, and after the removal of silica, the walls of the obtained porous hydrogels were less damaged compared to the use of unmodified filler, which has a positive effect on the physical and mechanical properties of the hydrogel (Fig. 1).

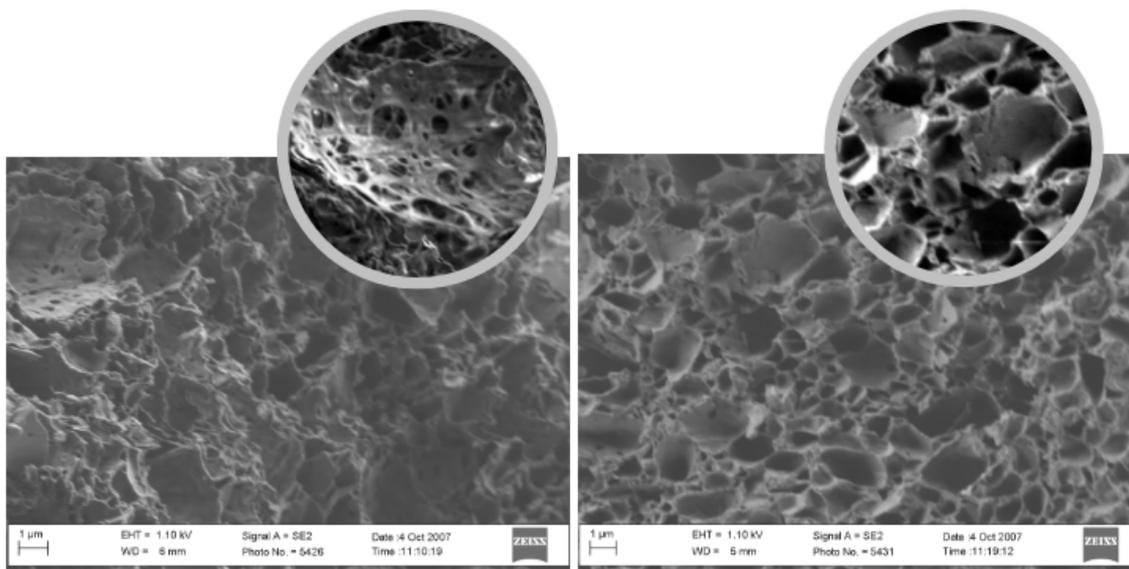


Fig. 1. SEM micrographs of porous gels obtained using filler (SiO_2): a) unmodified, b) modified. The degree of filling is 65%.

Thus, for the first time, a method for the porous hydrogels preparation using peroxidised filler particles to form a filled polymeric hydrogel framework allows creating porous hydrogels with adjustable mechanical properties at a higher degree of porosity when removing the filler.