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POSTER ABSTRACT PRESENTATIONS

SESSION TITLE: EM RESEARCH RELATED TO MEDICINE

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Abstract P-42: Structure of Hydrogels of an Anionic Polysaccharide Studied by Freeze-Fracture Transmission Electron Microscopy

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Background: Polysaccharide hydrogels draw attention due to the ability to form mechanically tough gels at low concentrations (typically 1 wt% or lower), combined with biocompatibility and biodegradability. Biopolymer hydrogels can be used as a matrix for cell growth, in order to obtain materials for the replacement of damaged tissues. “Physical” gels with macromolecules cross-linked by dynamic reversible cross-links are of great interest due to their self-healing ability. However, investigation of the native un-perturbed structure of such hydrogels presents a challenge, since they collapse upon drying, and present a difficulty for preparing a thin specimen for cryo-TEM experiments due to very high viscosity. The aim of this work is to study the native structure of hydrogels of an anionic polysaccharide – carboxymethyl hydroxypropyl guar (CMHPG) – cross-linked by borax.

Methods: Freeze-fracture transmission electron microscopy (FF-TEM) was conducted on a Phillips EM-301 microscope. A small volume of the sample (100 µl) was put into the copper cell and cooled down by liquid nitrogen, put under vacuum (10^{-5} torr) at continuous cooling with liquid nitrogen, and fractured. The surface was etched for 10–20 min at 10^{-5} torr and then replicated by spraying platinum and carbon.

Results: The gels have a microphase-separated microstructure – a rather thick (several nm) polymer backbone is seen, which is presumably formed by multiple aggregated macromolecules, and meshes between the backbone do not contain polymer and are filled with solvent. Mesh size determined from the micrographs qualitatively coincides with the value determined from the elastic modulus of

the gels. Upon increasing the concentrations of cross-linker, the network becomes denser: the mesh size becomes lower, and the thickness of the backbone increases. Thus, the addition of cross-linker favors the aggregation of polymer chains forming the backbone.

Conclusion: It was shown by FF-TEM that cross-linked CMHPG gels have a microphase-separated structure with a dense backbone formed by polymer chains and rather large meshes between them.

Key Words: polysaccharide • hydrogel • guar • FF-TEM

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