# HYDROPHILIC POLYMERS IN GELS AND SOLUTIONS: SURFACE PROPERTIES AND STUCTURE

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# ABSTRACT

Changes in the wetting properties of thin films of polyethyleneglycol (PEG) end-capped with fluoroalkyl groups are measured when the films are equilibrated at various relative humidity (RH). At high RH, the advancing contact angle ($\theta_{\text{adv}}$) on the surfaces is 20º higher than $\theta_{\text{adv}}$ measured at low RH. The surprising transition to non-wetting character at high RH is attributed to fluoroalkyl groups ordering at the air-hydrogel interface when they are liberated by dissolution of PEG crystallites above 85% RH.

The structure and tribology of a semi-interpenetrating hydrogel of agarose and an anionic polysaccharide (either hyaluronic acid or dextran sulfate) were studied. The porous structure of agarose allows incorporation of up to 2% dextran sulfate without weakening the gel's mechanical properties. Addition of the polyelectrolyte endows the gels with shape memory upon drying and reswelling; the gel can be dehydrated and rapidly swollen back to its original dimensions. The addition of both dextran sulfate and hyaluronic acid (HA) increases the lubricity of agarose when tested against hydrophilic clean glass or hydrophobic fluorinated glass. Migration of the polyelectrolytes out of the gel is believed to make the gels self-lubricating.

A variety of hydrophilic polymers were screened to identify those polymers which enhance the viscosity of HA solutions. Because HA degrades quickly in water, more stable polymers might form mixtures in which the mechanical properties of the solution are less sensitive to decreases in HA molecular weight during storage. Four polymers, all polysaccharides with persistence lengths greater than HA, were found to enhance HA viscosity. This viscosity enhancement was hypothesized to be due to greater concentration fluctuations in these solutions.

Finally, hydrophilic polymers were functionalized with photoresponsive hyrophobes in an attempt to control polymer self-assembly with light. Micelles of PEG end-capped with azobenzene molecules showed no change in size when the solutions were irradiated with UV light. PEG block copolymers were also functionalized with azobenzene and used to modify gold surfaces, but photoresponsive contact angles could not be measured. Finally, acrylamides copolymerized with the vinyl derivatives of malachite green were also studied, but the copolymers proved unsuitable for use at moderate pH.

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