High-energy radiation, such as gamma (γ) and electron beam radiation can be used to polymerize unsaturated compounds. Photo-crosslinkable NIPAAm copolymers with a UV-reactive benzophenone (BP) conjugated comonomer have been designed (Matsukuma et al. 2006). The photo-cross-linking was carried out by making use of the photochemistry of the BP groups, the photochemically produced triplet state which can abstract hydrogen atoms from almost any polymer, thus generating radicals.

## The Properties of Water and its Role in the Hydrogel

A gel can hold an extraordinary amount of water even 99%. Thus the hydrogel is essentially water. It holds together the polymeric materials and water nicely although slightly wet. Thinking of the mechanical properties coming solely from the polymeric matrix does not seem reasonable. The overall behaviour and the technological performance of hydrogels are determined, to a large extent, by the amount, structure and properties of water as well the characteristics assumed by it in contact and interacting with the solid polymeric network (Fig. 4).

As a whole, water is a typical substance with unusual properties (Wiggins 2008; Chaplin 2000). For instance, the boiling point of water is too high in comparison with hydrides of B, C, N, F, S, Se, and Te due to much stronger hydrogen bonding. Extrapolation of the relationship between the boiling points of hydride compounds and their molecular weights gives an expected boiling point for water of about 75°C. There are many other unusual properties of water such as too high melting and critical points, surface tension, viscosity, heat of vaporization, short NMR spin-lattice relaxation time at low temperatures, a wider variety of stable (and metastable) crystals and amorphous structures of solid water than other materials; faster freezing of hot water than cold water (Mpemba effect); anomalously fast mobility of protons and hydroxide ions under an electric field; high dielectric constant, etc. (Chaplin 2000) up to 72 anomalies.

Water can be thought of as a structure where extensive connectivity of different regions is established by the hydrogen bonds. There are changes in time with a constantly varying local structure arising from the rearrangement of the local

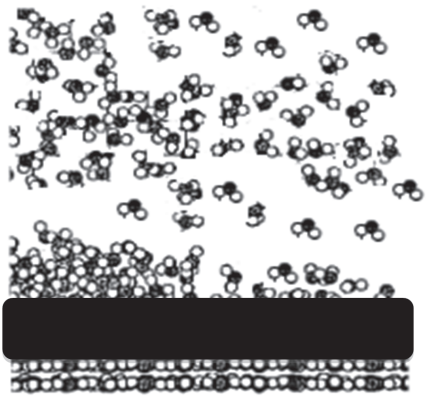

**Fig. 4.** The disposition of water in the bulk and interacting with the surface.