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Spontaneous Generation of Wrinkled Patterns on pH-Sensitive Smart-Hydrogel Films

Authors : Carmen M. Gonzalez-Henriquez, Mauricio A. Sarabia-Vallejos, Juan Rodriguez-Hernandez

Abstract : DMAEMA, as a monomer, has been widely studied and used in several application fields due to their pH-sensitive capacity (tertiary amine protonation), being relevant in the biomedical area as a potential carrier for drugs focused on the treatment of genetic or acquired diseases (efficient gene transfection), among others. Additionally, the inhibition of bacterial growth and, therefore, their antimicrobial activity, can be used as dual-functional antifogging/antimicrobial polymer coatings. According to their interesting physicochemical characteristics and biocompatible properties, DMAEMA was used as a monomer to synthesize a smart pH-sensitive hydrogel, namely poly(HEMA-co-PEGDA575-co-DMAEMA). Thus, different mole ratios (ranging from 5:1:0 to 0:1:5, according to the mole ratio between HEMA, PEGDA, and DEAEMA, respectively) were used in this research. The surface patterns formed via a two-step polymerization (redox- and photo-polymerization) were first chemically studied via 1H-NMR and elemental analysis. Secondly, the samples were morphologically analyzed by using Field-Emission Scanning Electron Microscopy (FE-SEM) and Atomic Force Microscopy (AFM) techniques. Then, a particular relation between HEMA, PEGDA, and DEAEMA (0:1:5) was also characterized at three different pH (5.4, 7.4 and 8.3). The hydrodynamic radius and zeta potential of the micro-hydrogel particles (emulsion) were carried out as a possible control for morphology, exploring the effect that produces hydrogel micelle dimensions in the wavelength, height, and roughness of the wrinkled patterns. Finally, contact angle and cross-hatch adhesion test was carried out for the hydrogels supported on glass using TSM-silanized surfaces in order to measure their mechanical properties.

Keywords : wrinkled patterns, smart pH-sensitive hydrogels, hydrogel micelle diameter, adhesion tests
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