Drug release from oral pharmaceutical tablets or pellets can be modified by the application of a polymer coating with controlled mass transport properties. When the coating film is made from a blend of polymers, the polymers can phase-separate and form domains enriched in either one. It is common to use a blend of a water-soluble and a water-insoluble component. Exposure to water may then cause the water-soluble polymer to leach out and create water-filled pores through which the drug can be released[1]. Thus, the pore network evolves with time and the permeability toward water and drug increases. The size and connectivity of domains in the phase-separated system affect the dynamics of this process as well as the structure of the evolving pore network. We recently studied the water transport through phase-separated polymer films made from a blend of water-insoluble ethyl cellulose (EC) and water-soluble hydroxypropyl cellulose (HPC)[2]. Using a novel ESEM-based method[3] for in situ controlled wetting, we obtained visual information about the water transport through such films for the first time. Local variations in permeability could be detected and correlated with the phase-separated microstructure, as shown in Fig. 1 and 2. Moreover, varying the blend ratio of the polymers significantly affected the film microstructure and water transport properties. Current studies focus on the transport mechanisms involved in the initial stages of wetting of EC/HPC films. Using a variety of techniques such as in situ ESEM, FIB-SEM and TEM, we investigate the dynamics of water transport through the films as well as the structure of the phase-separated system on the micro and nano scale. An important theme is the swelling and dissolution of HPC and its role in the water transport observed in the in situ ESEM wetting experiments. Our approach differs from traditional methods, where diffusion measurements and microstructural investigations are performed in separate and the main focus is the transport through the pore network after leaching of the HPC. It provides new and otherwise inaccessible information about the processes occurring as the material goes from dry to wet, which may increase the understanding of the function of EC/HPC films as oral controlled release coatings on tablets or pellets.


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Fig. 1: ESEM image of the surface of an EC/HPC film containing 70% EC and 30% HPC. Dark regions are HPC domains and bright are EC.

Fig. 2: ESEM image of the same EC/HPC film as in Figure 1, a few minutes after the opposite surface was exposed to water. Droplets of water and dissolved HPC have formed on the film surface and appear as bright regions in the image, indicating water transport through the film.