# Characterization Of A Polymeric Membrane Containing Responsive Nanoparticles By Impedance Spectroscopy

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## Abstract

Nowadays polymeric membranes of a wide variety of materials and structures are used in medical and industrial applications. However, the development of artificial membranes is still far away from the speciality and perfection of biological membranes, whose selectivity is controlled by external stimuli like electrical potential, ionic concentration, pH or temperature. Different types of polymeric materials are responsive to external stimuli, which are denominated as "smart polymers", and they are widely investigated to develop smart membranes with controllable selectivity.

Poly(2-vinylpyridine) hydrogels is a polymer responsive to pH. The swelling state of p(2-VP) nanoparticles (microgel) depends strongly on the pH, and also on the salt concentration, of the medium. Recently, an inert porous membrane has been loaded with these microgel particles to develop a smart membrane (SM) with a pH-dependent ionic selectivity [1].

The salt permeability of the loaded membrane is reduced to approximately 50% that of the inert support, which shows the presence of the microgel particles inside the membrane pores. Additionally, the SM permeability decreases about 40% when the microgel is in the swollen state (low pH), while the permeability of the inert support is not modified by the pH.

In this work, this smart membrane is characterised by impedance spectroscopy (IS) in order to study the electrical properties of the new membrane by using equivalent circuits as models. The electrical response of both membranes in a frequency range from 1 to $10^7$ Hz is typical of porous membranes [2] and the associated circuit is given by a parallel combination of a resistance and a capacitor which represent the whole "membrane system" (membrane plus electrolyte placed between the membrane and the electrode surface). As expected, membrane resistance for the loaded sample is higher than that of the support membrane, but the influence of the degree of swelling of the microgel particles as a function of solution concentration and pH is being studied.

[1] M. J. Ariza, *21st Conference of the European Colloid and Interface Society*, Geneva (Switzerland), 2007.
[2] R. Fortunato, L.C. Branco, C.A.M. Afonso, J. Benavente, J.G. Crespo; *J. Membr. Sci.*, 270 (2006) 42.