O12 | **Proton conductivity and free volume properties in per-fluorinated sulfonic acid/PTFE copolymer for fuel cell**

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The mechanism of proton conductivity in per-fluorinated sulfonic acid/PTFE copolymer Fumapem® membranes for polymer electrolyte fuel cells has been investigated. Three different samples, Fumapem® F-950, F-1050 and F-14100 membranes with ion exchange capacity (IEC) = 1.05, 0.95 and 0.71 meq/g, respectively were used after drying. Free volume was quantified using the positron annihilation lifetime (PAL) technique while the proton conductivities (σ) were measured using LCR Bridge as function of temperature. It was found that as the ion exchange capacity increases, the proton conductivity increases and the free volume expands. Temperature dependences of free volume and also proton conductivity reflect the glass transition temperature of the membrane. Good linear correlations between the reciprocal of the *o*-Ps hole volume size ($1/V_{o\text{-}Ps}$) and Log (σ) + $\Delta E_a/2.303$ KT, [where ΔE_a is the activation energy, K is the Boltzmann constant and T is the absolute temperature] at different temperature indicate that the ionic motion in dry Fumapem® is governed by the free volume. A good linear correlation between the critical hole size γV_i^* and the ionic exchange capacity was achieved.