

# **12<sup>TH</sup> TIHANY SYMPOSIUM ON RADIATION CHEMISTRY**

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**PROGRAM AND ABSTRACTS**

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## STUDIES OF NETWORK STRUCTURE AND DYNAMICS OF E-BEAM CROSSLINKED PVPs: FROM MACRO TO NANO

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Much interest has been paid to develop a variety of radiation-crosslinked hydrated polymeric materials, which swell in water but do not dissolve, as biocompatible materials used for wound healing, drug delivery system, surface-coating material for medically used devices, etc. With the aim of establishing design rules to produce hydrogels of controlled size at the nanoscale and desired internal network structure using conventional electron accelerators and set-ups, here we attempt a description in terms of structural and dynamic properties of polymer networks generated through e-beam irradiation of aqueous solutions of the same model polymer, a commercial grade poly(N-vinyl-pyrrolidone), subjected to e-beam irradiation with a 12 MeV Linac accelerator, at same dose (40kGy) and dose-rate (100 kGy/h) and at the variance of polymer concentration in water. Concentration has been systematically varied from above (10, 8, 6, 4, 2 % w) to below (1, 0.5, 0.25, 0.1, 0.05 % w) the critical chain overlap concentration value (~1%w) of the chosen polymer in water, as estimated by intrinsic viscosity measurements. The transition between macroscopic gelation and micro-/nanogels formation is observed just below the critical overlap concentration (0.5 %w), whereas the net prevalence of intra-molecular over inter-molecular crosslinking occurs at a polymer concentration below 0.25 % w, as revealed by both dynamic and static laser light scattering measurements. Significant structural differences between nanoscale "finite" crosslinked networks and macrogels are evidenced by both FTIR and solid state NMR spectra. Polymeric segments mobility of the formed networks, at the different scales, has been assessed through stress-rheometry, solid-state cross-polarization times and nuclear relaxation time NMR studies of the freeze-dried residues.