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Aspects of Alternative Network Structure Evolution

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Abstract
The focus of this prospectus is to study a new and simple process method to prepare and characterize elastomers and hydrogels. A prestressed double network thermoplastic elastomer and hydrogel is prepared by a two step curing process where first network is introduced in the unstrained state, while the second is introduced in the strained state, hence varying prestress after first curing step. The focus of this thesis is towards the understanding of the basic network mechanism governing

the final physical, mechanical and thermo-mechanical properties of these prestressed double networks and relating them to their microstructure and morphology. Moreover, the major factors governing the final properties of these networks are being identified including the type of crosslinks, the extent of crosslinking in the two states of stresses/strains, mode of deformation and the behavior is compared with simple theoretical models.

The network structure of swollen hydrogel networks has been studied and the effect of various topological constraints ranging from the crosslinks to entangled linear chains to stiff nanofillers have been studied. The study has been utilized to propose a filler reinforcing mechanism for elastomeric networks and also identify the competition between the effect of various constraints in the final steady state and relaxation properties of the swollen hydrogel networks.

The final part of this thesis focuses towards the network evolution in ultra high molecular weight poly (tetrafluoroethylene) (PTFE) in its melt state. Initial studies on the viscoelastic properties of PTFE in its melt state has been discussed and later a method to alter the network evolution utilizing supercritical carbon dioxide has been discussed. The effect of supercritical carbon dioxide on the melt of PTFE has been observed by utilizing a new setup to understand the behavior of PTFE in-situ in presence of supercritical carbon dioxide.