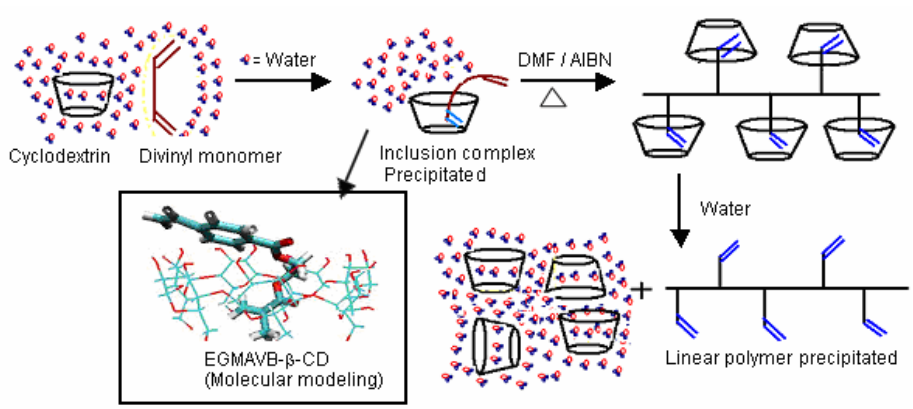
Functional polymers from divinyl monomers via cyclodextrin host guest chemistry

Crosslinked polymers find a wide range of applications such as ion exchange resins, adsorbents, molecularly imprinted polymers, supports for reagents in organic synthesis, enzyme immobilization and drug delivery systems. A sequential multistep approach, wherein, a soluble linear polymer is first synthesized, isolated and then crosslinked offers significant advantages in most applications. Therefore, there is a need to devise a one step methodology for the synthesis of soluble, linear and crosslinkable polymers.

Mohan G. Kulkarni and his colleagues Sunita S. Satav and Rohini N. Karmalkar at National Chemical Laboratory (NCL), Pune (www.ncl-india.org) in collaboratrion with M. Nagraju and G.N. Sastry of Indian Institute of Chemical Technology (www.iictindia.org) have developed a methodology for selective polymerization of divinyl monomers such as ethylene glycol dimethacrylate and ethylene glycol methacrylate 4-vinyl benzoate by exploiting the principles of host-guest chemistry.

Cyclodextrins are torus shaped cyclic oligosaccharides produced as a result of enzymatic degradation of starch by the cyclodextrin glucanotransferase enzyme. Cyclodextrins form inclusion complexes with large number of organic guest molecules. The physical properties such as solubility, stability, volatility are modified without affecting the chemical structure of the guest molecule. Cyclodextrins have been shown to solubilize vinyl monomers and enable their polymerization in aqueous media. These inclusion complexes have found numerous practical applications in chemistry, biology, and industries such as pharmaceuticals, food, cosmetic, perfumery, etc.



In the methodology developed at NCL / IICT, the water insoluble divinyl monomers form an inclusion complex with β-cyclodextrin and its derivatives such as dimethyl β-cyclodextrin. The vinyl group included in the cavity of β-cyclodextrin does not participate in polymerization. As a result, a divinyl monomer behaves as a monovinyl monomer. The polymerization results in a solvent soluble linear polymer containing one vinyl double bond per repeat unit.

Such “vinyl” functional polymers can be subsequently cross-linked by free radical initiators or by UV irradiation, to yield films, micro and nanoparticles as well as graft copolymers. Such crosslinked polymers may find application in various areas such as coatings, microelectronics, photoresists, molecularly imprinted polymers, ion exchange resins, as chromatography support, reagent in organic synthesis, drug delivery systems and other biomedical applications. Seven patent applications are pending covering various applications of this chemistry.

S.S. Satav, R.N. Karmalkar, M.G. Kulkarni, M. Nagraju and G. N. Sastry, Am. Chem. Soc. **128,** 24 (2006), 7752-7753.

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