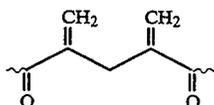
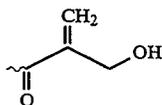
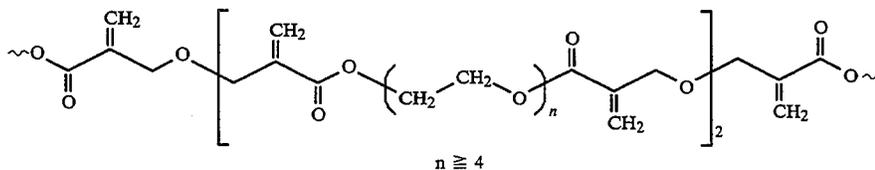
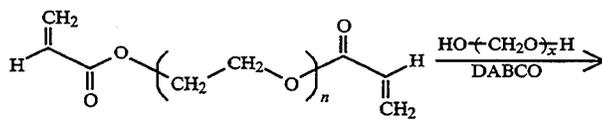
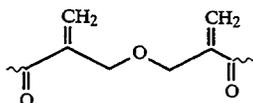


since various other embodiments can readily be evolved in view of the teachings provided herein.

These examples demonstrate the feasibility of synthesizing multifunctional vinyl oligomers containing ethylene oxide (hydrophilic) or siloxane (hydrophobic) segments.

Synthesis of ethylene oxide based multifunctional vinyl oligomers.

Polyethylene glycol (PEG) 400 diacrylate (average molecular weight=508, Scientific Polymer Products, Inc., Ontario, N.Y.), and paraformaldehyde (95%, Aldrich Chemical Co., Milwaukee, Wis.), 2 mmol (1.016 g) and 4 mmol (0.126 g), respectively, were combined with 0.2 mmol (0.0224 g) DABCO (Aldrich Chemical Co., Milwaukee, Wis.) in a sealed vial which was heated (oil bath) at 90°-95° C. for six hours. The clear, viscous liquid was isolated in ca. 85% yield by column chromatography (silica gel) using methanol as the eluant. As determined by ¹H NMR spectroscopy (NMR, JEOL GSX-270, Peabody, Mass.), the oligomeric product consisted mainly of segments having the in-chain structures designated by A (1,6-diene) and C (1,4-diene) and end groups such as B as shown below. The ratio of A:B:C was 6:3:1.



In a slightly modified preparation, the same starting mixture of reagents was reacted at 90°-95° C. for 20 hours. The following alternate product isolation procedure was used. The viscous, crude product contained no measurable amount of the PEG 400 diacrylate starting material as determined by ¹H NMR analysis. The oligomer was washed with several portions of carbon tetrachloride to remove any low molecular weight product as well as the DABCO reaction catalyst. The oligomer was then dissolved in chloroform and dried over anhydrous sodium sulfate. The solvent was removed under reduced pressure (to ca. 5 Pa) to provide the PEG 400 oligomer as a viscous pale yellow oil in ca. 63% yield. Characterization of the product by ¹H NMR

indicated no unreacted acrylate end groups and an average of 3.7 repeat units per oligomer. This corresponds to a molecular weight of ca. 2700 for the oligomer. The repeating diene structure of the oligomer was predominantly 1,6; about 8% of the diene units had the less common 1,4 orientation.

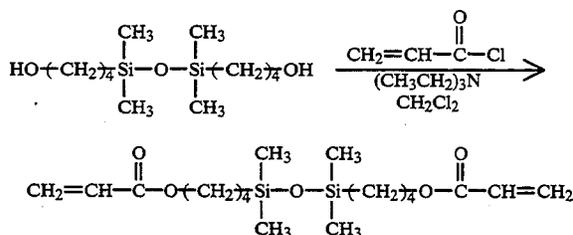
IR (neat) 3465, 2868, 1720, 1636, 1109 cm⁻¹. ¹H NMR (CDCl₃) δ 3.65 (internal OCH₂CH₂O), 3.77 (OCH₂CH₂O₂C), 4.25 (CH₂OH), 4.28 (CH₂OCH₂), 4.33 (CH₂O₂C), 5.84 (HOCH₂C=CH₂), 5.92 (CH₂OCH₂C=CH₂), 6.29 (HOCH₂C=CH₂), 6.34 (CH₂OCH₂C=CH₂)

The ethoxylated oligomeric multifunctional vinyl monomer derived from polyethylene glycol (PEG) 200 diacrylate (molecular weight=302, Scientific Polymer Products, Inc., Ontario, N.Y.) was synthesized and characterized in a similar manner. The PEG 200 oligomer, prepared under the same conditions described above (90°-95° C. for 20 hours), contained an average of 4.2 repeat units per oligomer having mainly 1,6-diene units with only 6% 1,4-diene units. The average molecular weight of the PEG 200 oligomer was only ca. 1900 due to the shorter ethylene oxide chain length compared with that in the PEG 400 material; however, it was slightly more viscous than the PEG 400 oligomer.

The following generalized scheme indicates the oligomerization/condensation reaction of formaldehyde with poly(ethylene oxide) based diacrylates.

Synthesis of tetramethyldisiloxane based multifunctional vinyl oligomers.

The starting siloxane diacrylate, 1,3-bis(4-acryloxybutyl)tetramethyldisiloxane, was synthesized as shown from the corresponding diol, 1,3-bis(4-hydroxybutyl)tetramethyldisiloxane (Columbia Organic Chemicals Co., Columbia, S.C.) and acryloyl chloride in the solvent dichloromethane using triethylamine as the catalyst/acid acceptor.



The siloxane diacrylate was isolated in 85% yield and characterized by infrared and ¹H NMR spectroscopy, respectively.

IR (neat) 2945, 1718, 1631, 1401, 1264, 1254, 1060, 950, 840 cm⁻¹. ¹H NMR (CDCl₃) δ 0.00 (s, Si-CH₃),