ABSTRACT

Polymers are giant molecules that have a wide application in various fields of science and engineering. They have become a part of our domestic life such as packaging materials, dress materials and electronic devices. The bio-medical applications of polymers are found to be lesser when compared to the packaging sectors because of its non biodegradability and non biocompatibility. This can be tackled by making it amphiphilic diblock copolymer. The application of polymer are extended to the biomedical engineering such as drug carriers, scaffolds and splinting materials. It was proved that the polymer nanoparticles or nanomicelles play a vital role in the drug delivery process. In the present investigation a hydrophobic poly (caprolactone) (PCL) and a hydrophilic poly (tetrahydrafuran) (PTHF) were synthesized using an amino acid as a single initiator. The first and foremost target of the present investigation is synthesis, characterization and application such as low temperature splinting material and catalytic activity with antimicrobial property and is less commonly available in the literature. This urged us to do the present investigation.

PCL is a bio-medical polymer with a hydrolysable ester linkages. PTHF is also a bio-degradable polymer with a hydrolysable ether linkages. In the first step an amino acid was used as an initiator towards the Ring Opening polymerization (ROP) of caprolactone (CL). The ROP of CL was carried out at 160 °C under N₂ atmosphere with mild stirring condition. Here the Monomer to Initiator ratio [M/I] was maintained as 100. Thus obtained polymer was characterized by various analytical techniques such as Fourier Transform Infrared Spectroscopy (FTIR), UV-visible Spectroscopy, Nuclear Magnetic Resonance Spectroscopy (NMR), Fluorescence Emission Spectroscopy, Differential Scanning Calorimeter (DSC), Thermal Gravimetric Analyzer (TGA), Field Emission Scanning Electron Microscope (FESEM),
Zeta Potential, High Resolution Transmission Electron Microscope (HRTEM), Energy Dispersive X-ray analysis (EDAX), Gel Permeation Chromatography (GPC), Circular Dichroism (CD) Spectroscopy like analytical tools. The polymer synthesized in the first step is designated as P1. In the second step the P1 was used as a macro initiator towards the ROP of THF in the presence of phthalic anhydride as a comonomer with the aid of stannous octoate (Sn(Oct)$_2$) as a catalyst. The ROP of THF was carried out at 45 °C for 48 h under N$_2$ atmosphere with vigorous stirring condition. The diblock copolymer obtained in the second step is known as amphiphilic diblock copolymer and is designated as P2. The polymer obtained in the second step is also characterized by above said techniques. In the third step, nano Ag end capped diblock copolymer was synthesized using P2 in the presence of silver nitrate (AgNO$_3$). The Ag nanoparticle formation can be explained on the basis of polyol methodology and reduction by amino or thiol group. The polymer obtained in the third step with antimicrobial property and is designated as P3.

The polymers synthesized in the present investigation have a wide application in the field of bio-medical engineering and catalysis. The low temperature splinting activity of a polymer was tested by coating the same with the raw polyester fabric. The resultant material with high tensile strength, % elongation proved the suitability towards low temperature splinting activity. The wound healing activity was tested in terms of determining the water and chloroform absorption. Further, the polymer was subjected to a catalysis field as a catalyst. The reduction of nitrophenol in the presence of P3 was carried out, due to the difference in shape and size of the Ag nanoparticle. The apparent rate constant was determined. The result obtained in the present investigation is typically analyzed and compared with the literature report carefully. From the present investigation we opened a new route for the fabrication of low temperature splinting material and a
heterogeneous characteristic catalyst. In all aspects, one can found that the present system yielded excellent results.