World Academy of Science, Engineering and Technology
International Journal of Materials and Metallurgical Engineering
Vol:11, No:06, 2017

Monitoring the Thin Film Formation of Carrageenan and PNIPAm Microgels

Authors : Selim Kara, Ertan Arda, Fahrettin Dolastir, Önder Pekcan

Abstract : Biomaterials and thin film coatings play a fundamental role in medical, food and pharmaceutical industries. Carrageenan is a linear sulfated polysaccharide extracted from algae and seaweeds. To date, such biomaterials have been used in many smart drug delivery systems due to their biocompatibility and antimicrobial activity properties. Poly (N-isopropylacrylamide) (PNIPAm) gels and copolymers have also been used in medical applications. PNIPAm shows lower critical solution temperature (LCST) property at about 32-34 °C which is very close to the human body temperature. Below and above the LCST point, PNIPAm gels exhibit distinct phase transitions between swollen and collapsed states. A special class of gels are microgels which can react to environmental changes significantly faster than microgels due to their small sizes. Quartz crystal microbalance (QCM) measurement technique is one of the attractive techniques which has been used for monitoring the thin-film formation process. A sensitive QCM system was designed as to detect 0.1 Hz difference in resonance frequency and 10-7 change in energy dissipation values, which are the measures of the deposited mass and the film rigidity, respectively. PNIPAm microgels with the diameter around few hundred nanometers in water were produced via precipitation polymerization process. 5 MHz quartz crystals with functionalized gold surfaces were used for the deposition of the carrageenan molecules and microgels in the solutions which were slowly pumped through a flow cell. Interactions between charged carrageenan and microgel particles were monitored during the formation of the film layers, and the Sauerbrey masses of the deposited films were calculated. The critical phase transition temperatures around the LCST were detected during the heating and cooling cycles. It was shown that it is possible to monitor the interactions between PNIPAm microgels and biopolymer molecules, and it is also possible to specify the critical phase transition temperatures by using a QCM system.

Keywords : carrageenan, phase transitions, PNIPAm microgels, quartz crystal microbalance (QCM)
Conference Title : ICPMSET 2017 : International Conference on Polymer Materials Science, Engineering and Technology
Conference Location : Copenhagen, Denmark
Conference Dates : June 11-12, 2017

Open Science Index, Materials and Metallurgical Engineering Vol:11, No:06, 2017 publications.waset.org/abstracts/70422.pdf