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Composition Tunability and pH-Responsive Wettability of Plasma Copolymer Films Prepared from Acrylic Acid and Octafluorocyclobutane

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Plasma copolymerization has become encouraging and versatile route for the deposition of thin film, as it is easy to obtain desired chemical functionalities in the material by controlling the monomer feed rate and power. In this work, the plasma copolymerization of two monomers of acrylic acid (AA) and octafluorocyclobutane (C_4F_8) is studied by capacitively coupled radio frequency plasma (CCP) under the radio frequency (RF) power of 50 and 100 W. The plasma copolymer is deposited on low density polyethylene (LDPE) under constant flow of C_4F_8 along with various flow rate of AA. The plasma copolymer films are characterized by the Fourier transform infrared spectroscopy (FTIR), the X-ray photoelectron spectroscopy (XPS) and contact angle measurements. The concentration of carboxylic based functional groups in the plasma copolymer films increases with the increase of the AA monomer flow rate. The low power is more favorable for retention of carboxylic based functional groups and high power is for fluorine based functional groups. The water contact angles (WCA) of the plasma copolymer films decrease with the increase of the carboxylic based functional groups. The pH-responsive property of the wettability of the plasma copolymer films is investigated. The copolymer film shows the changes of WCA from 82±4° to 50±4° when pH value changed from 1 to 13. The reversible transformation of WCA is achieved by the periodic changes of pH environment. This pH-responsive wettability can be explained by the protonation and deprotonation of carboxylic groups in the plasma copolymer films.

Keywords
Capacitively coupled radio frequency plasma
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Wettability
pH-responsive property