

Public Abstract

First Name: Mary

Middle Name: A

Last Name: Gilliam

Degree: PhD

Degree Program: Chemical Engineering

Advisor's First Name: Qingsong

Advisor's Last Name: Yu

Co-Advisor's First Name:

Co-Advisor's Last Name:

Graduation Term: Summer

Graduation Year: 2006

Title: A PLASMA POLYMERIZATION INVESTIGATION AND LOW TEMPERATURE CASCADE ARC PLASMA FOR POLYMERIC SURFACE MODIFICATION

Plasma polymerization of fluorocarbon systems was investigated using the monomers C₃F₆, C₂H₂F₄, C₄F₁₀ and C₃F₆O, which were compared to methane and butane. In fluorocarbon discharges, the luminous gas phase does not contain much polymer-forming species and the monomer deficient domain shifted to low W/FM and low GR/FM. Furthermore, for hydrocarbon systems, deposition rate was greater for RF than for AF, which was the opposite for the fluorocarbon discharges. These differences were attributed to the nature of fluorocarbons and the locations of the dissociation glow.

Surface modification treatments were performed on seven polymers using low temperature cascade arc torch (LTCAT) of Ar with or without adding reactive gas of O₂ or H₂O. Ar LTCAT treatments with low treatment times (2 s) resulted in stable, hydrophilic surfaces without surface degradation from oligomer formation, with the exception of nylon-6. The surface stability induced from Ar LTCAT treatments was attributed to the CASING effect (cross linking via activated species of inert gas). Addition of O₂ or H₂O vapor into Ar LTCAT resulted in greater wettability, but enhanced oligomer formation, which was more pronounced with H₂O. The surface oligomer formation was attributed to alkoxy degradation reactions and enhanced chain scission.

A stainless steel mesh was placed in LTCAT to remove ions and study the disturbance effects on LTCAT and on polymeric surface modification. The excited neutral species of Ar were greatly reduced by the mesh placement. In addition, grounding the mesh significantly altered the nature of the discharge. The dynamic surface characterization data indicated that while a decrease in surface damage was observed by placement of the mesh, the wettability achieved was also greatly reduced.