A Study on Elongation/Contraction Behavior and Mechanical Properties of Oxy-Polyacrylonitrile(PAN) Fiber in Basic/Acidic Solution for Artificial Muscle Applications

Young Kwan Lee*, Sang Wan Kim, Kyung Sup Lee, In Hee Cho, Joo Hwa Lee, Jin Woo Lee, Kwang Jin Kim**, and Jae-Do Nam†
Department of Polymer Science and Engineering, *Department of Chemical Engineering, Polymer Technology Institute, SungKyunKwan University, Suwon 440-746, Korea
**Department of Mechanical Engineering, University of Nevada, Reno, USA
†e-mail: jdanm@skku.ac.kr
(Received March 14, 2002; accepted June 24, 2002)

ABSTRACT: Oxy–PAN fiber prepared from the preoxidation and saponification of raw PAN fiber is known to elongate and contract when immersed in basic and acidic solutions, respectively. In this study, about 30% elongation in NaOH solution and 30–50% contraction in HCl solution have been observed. In mechanical test, the mechanical properties of oxy–PAN fiber in the contracted state was stronger than that in the elongated state. These behaviors and mechanical properties are compared to those of living muscle and linear actuator. The change of length in NaOH and HCl solutions is due to switching between a hydrophilic and a hydrophobic structure. Other reasons are exchange of ion and water in/out of oxy–PAN fiber, and osmotic pressure difference associated with relevant ions. Much studies are needed to clarify the effective factors on but the oxy–PAN fiber’s elongation/contraction behavior and mechanical properties, but the oxy–PAN fiber prepared in our laboratory has a sufficient potential for application as artificial muscle and linear actuator.

Keywords: oxy–PAN fiber, elongation, contraction, artificial muscle, linear actuator.