10th International Conference on Composite Science and Technology
ICCST/10
A. L. Araújo, J. R. Correia, C. M. Mota Soares, et al. (Editors)

Abstract ID-80

PEELING FORCE OF FLUORORESIN/PDMS LAMINATED SHEET ASSISTED BY HOMOGENEOUS EB-IRRADIATION UNDER HIGH TEMPERATURE OF 363 K

Chisato Kubo, Masae Kanda, Yoshitake Nishi

Tokai University, Japan
4bazm009@mail.tokai-u.jp, mk0527@hotmail.co.jp, am026429@keyaki.cc.u-tokai.ac.jp

Keywords: Adhesion, EB-Irradiation, Temperature, Fluororesin, PDMS

Summary: Composite polymers have been prepared for numerous biomedical applications by laminating them with heating and glue. However, these methods often degrade the adhesive strength and chemical properties, thereby affecting human health. Development of rapid adhesion without heating and glue would remedy this. To solve the problem, the development of rapid adhesion method between Fluororesin and Polydimethylsiloxane (PDMS) sheets has been expected. Fluororesin exhibits high wear resistance as well as high strength and fracture toughness. It can be applied to artificial blood vessels. PDMS exhibits high transparency and bio-adaptability and has been mainly applied to contact lens. In addition, since the PDMS also shows self-adhesive, it can be expected to utilize for wrapping the bio-medical sensors.
The effects of homogeneous low voltage electron beam irradiation (HLEBI) at high temperature on the adhesive force of peeling (oFp) at accumulative probability of peeling (Pp) of laminated Fluororesin/PDMS sheets of Fluororesin and PDMS) under high temperature (363 K) was investigated without glue. oFp values at each Pp of Fluororesin/PDMS laminated sheets irradiated of 0.04 to 0.43 MGy at high, room and low temperature exceed the corresponding values of the untreated samples.
HLEBI was performed by using electron-curtain processor (Type CB175/15/180L, Energy Science Inc., Woburn, MA, Iwasaki Electric Group Co., Ltd., Tokyo). Given the densities (μ) are 2.10 g /cm3 for Fluororesin and 1.01 g /cm3 for PDMS, the penetration depth (Dth) values of 105 μm for PTFE and 219 μm for PDMS were estimated by assumptions of Christenhusz and Reimer, respectively. In addition, the Dth values of Fluororesin (152 μm) and PDMS (378 μm) were also calculated by the assumptions of Libby. Consequently, since the irradiated sample thickness of laminated composites with Fluororesin film (50 μm thickness) and PDMS film (75 μm thickness) was 125 μm, the adhesive interface is perfectly irradiated throughout their thicknesses.
The relationships between oFp and the accumulative probability of Pp of Fluororesin/PDMS laminated sheets before and after HLEBI under high (363 K) was investigated without glue were obtained. The oFp value of 40 kGy-HLEBI under 363 K was 5.52 Nm-1, which was higher than those (4.89 and 4.68 Nm-1) of 40 kGy-HLEBI under 298 and 77 K, respectively. The highest oFp value of Fluororesin/PDMS laminated sheets irradiated at small dose of 40 kGy under high temperature of 363 K is found. Based on the results of X-ray photoelectron spectrometer (XPS), fluorine was found in the PDMS side peeled surface. No signals can be observed in the samples untreated. Since the XPS signal heights of Fluororesin/PDMS treated HLEBI under high temperature is higher than that under room temperature, the high temperature-HLEBI easily accelerates mass transport at the interface of the Fluororesin/PDMS adhesion. Therefore, the high temperature-HLEBI with small dose of 40 kGy was useful tool for quick strong Fluororesin/PDMS lamination with sterilization for bio-adaptable application.