Sensors and Materials, Vol. 22, No. 5 (2010) 235–245
MYU Tokyo

S & M 0805

Ionizing Radiation Sensor Utilizing Radiophotoluminescence in Ag^+-Activated Phosphate Glass and Its Application to Environmental Radiation Monitoring

Yuka Miyamoto[1,2], Kazuya Kinoshita[2], Haruki Kobayashi[2], Akihiko Fujiwara[2], Shin Koyama[2], Yoshinori Takei[2], Hidehito Nanto[2,*], Takayoshi Yamamoto[1], Toshio Kurobori[3], Takayuki Yanagida[4], Akira Yoshikawa[4], Masaaki Sakakura[5], Yasuhiko Shimotsuma[5], Kiyotaka Miura[5] and Kazuyuki Hirao[5]

[1]Oarai Research Center, Chiyoda Technol Corporation,
3681 Narita-cho, Oarai-machi, Higashi-ibaraki-gun, Ibaraki 311-1313, Japan
[2]Advanced Materials. Science Research and Development Center, Kanazawa Institute of Technology,
3-1 Yatsukaho, Hakusann-shi, Ishikawa 924-0838, Japan
[3]Nature Science, Kanazawa University, Kakuma-cho, Kanazawa, Ishikawa 920-1192, Japan
[4]Division of Advanced Crystal Materials, Tohoku University,
Katahira, Sendai, Miyagi 980-0557, Japan
[5]Department of Materials Chemistry, Graduate School of Engineering, Kyoto University,
A3-119 Katsura, Kyoto-University, Nishikyo-ku, Kyoto-shi, Kyoto 615-8510, Japan

(Received October 16, 2009; accepted April 26, 2010)

Key words: radiophotoluminescence, glass dosemeter, Ag^+-activated phosphate glass, photoreduction, femtosecond laser pulse, environmental radiation

Optical properties such as optical absorption spectrum and radiophotoluminescence (RPL) emission and excitation spectra of Ag^+-activated phosphate glass before and after X-ray irradiation were investigated in this study. It is found that the RPL emission spectrum consists of two emission band peaks at about 460 (blue luminescence) and 560 nm (orange luminescence). The excitation spectrum of RPL consists of two excitation bands at about 315 and 360 nm. It is also found that 560 nm RPL peak intensity gradually increases with time after exposure to X-rays, which strongly suggests that the 560 nm RPL peak is ascribed to Ag^{2+} ions. The 460 nm RPL peak is ascribed to Ag^0 ions, because a blue luminescence is observed in femtosecond pulsed laser light-irradiated glass, in which Ag^0 ions are produced by the photoreduction process of Ag^+ ions in glass. The application of the RPL phenomenon in Ag^+-activated phosphate glass to the environmental monitoring of ionizing natural radiation is also demonstrated.

*Corresponding author: e-mail: hnanto@neptune.kanazawa-it.ac.jp