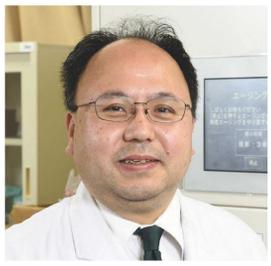
Department of Applied Nuclear Technology	Key words	Radiation Chemistry, Radiotherapy, Chemistry Dosimeter, Gel Dosimeter, Radiation Visualization Technology



Ph.D. (Engineering) / Professor

Takeyoshi Sunagawa

Education

JSPS Research Fellow, Visiting Associate Professor, The Institute of Scientific and Industrial Research, Osaka University, Lecturer, Assistant Professor/Associate Professor, Fukui University of Technology

Professional Background

JSPS Research Fellow, Visiting Associate Professor, Institute of Industrial Science, Osaka University, Lecturer, Assistant Professor/Associate Professor, Professor Fukui University of Technology

Consultations, Lectures, and Collaborative Research Themes

Medical use of radiation, basic processes and applications of radiation chemistry, radiation shielding technology, radiation visualization technology

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Main research themes and their characteristics

「Development of Highly Sensitive Gel Dosimeter Used for Radiology」

In recent years, use of radiation beams or particle beams have been put to practical use for cancer therapy. In cancer radiation therapy, visualization of radiation patterns is absolutely necessary for precisely evaluating the dose distribution. Therefore, gel type or Fricke type dosimeters are considered useful for visualization. In this study, we developed a new type of gel dosimeter using a doped polyvinyl alcohol (PVA) based solution. This gel uses a red color based chemical reaction that occurs when the active agent is separated. Irradiation of the gel with X-rays is sufficient to break the chemical bonds of the active agent.

We irradiated different gel samples with X-rays from a Hitachi MBR-1520R-3 source under different configurations to test the gel performance. We used UV-VIS spectrometry to measure the absorbance of transmitted light through the gel. For the active agent, the absorbance is at a peak wavelength of 490 nm. The amount of absorbance is proportional to the number of interactions with X-rays. We irradiated the gel between 0.5Gy- 10Gy with visualization of the gel by photography and spectrometry between each irradiation. The spectrometry was performed using a StellarNet Black Comet system observing the absorbance between 300nm and 700nm.

In Fig.1, the results show that as the X-ray dose increases, the gel transitions from a clear gel to a light pink gel and then to a red gel. All colors are translucent and allow for the passage of light. The first samples were done in clear plastic containers of 250 ml size. The containers were filled with gel to eliminate air and possible oxygen contamination. The second set of experiments repeated the first study but used metallic coins as X-ray shields. The regions covered by the coins were protected from the dose and remained clear. A sharp edge was observed at the edge of the coin. This implies that the gel does not diffuse and hence can represent a dose distribution as long as it is not mixed. The third samples were placed in disposable cells for measurement of absorbance. In Fig.2, the absorbance had a peak in the vicinity wavelength of 490nm. In Fig.3, the results confirmed the absorbance to be proportional for increasing applied dose. In summary, a color transition gel was developed for use in detecting irradiation dose from X-rays. This technique has potential application for visualization of dose during medical procedures.

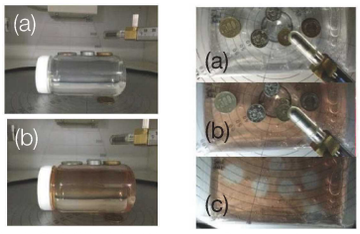

Fig.1 Gel filled bottle and Gel sheet in X-ray Irradiation: (a) befor irradiation, (b) after exposure (c) after exposure but with shuelding coin removed. to 2 Gy of 150 keV X-ray

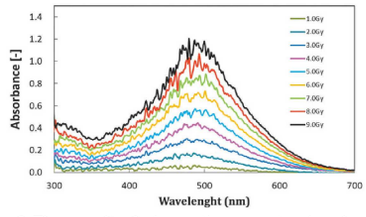

Fig.2 The result of absorption spectrochemical analysis

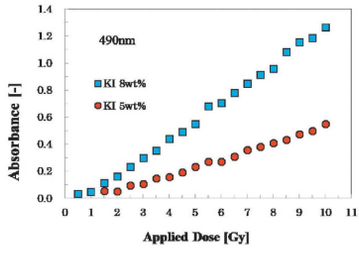

Fig.3 Result of absorbance at 490 nm by X ray irradiation

Major academic publications

Patent No. 6714231 "Radiation-sensitive gel indicator and its preparation method, its use method, and its treatment method" Inventor Takeyoshi Sunagawa et.al. (filing date July 20, 2016, registration date June 9, 2020)

Takeyoshi Sunagawa et.al. , “Development of the Gel Indicator Using PVA and KI”, Memoirs of Fukui University of Technology (47), 105-110, 2017

"Recommendation for Radiation Chemistry" Japanese Society for Radiation Chemistry (Editor) Academic Publishing Center (2006 ISBN4-7622-3050-2)