

SPECTRA AND TIME PROFILE CHARACTERISTICS OF TWO COLOR SCINTILLATION MONITORS FOR ELECTRON AND ION BEAMS

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Abstract

Desmarquest AF 995 R is very sensitive scintillation materials with very high radiation resistance. It has very sharp visible emission band with broad shoulder parts at both shorter and longer wavelength sides and broad ultraviolet emission. The time profile of ultraviolet emission has the same time profile as the time profile of the electron pulse even for a 10 picosecond electron pulse. The visible bands have long lifetimes. Demarquest AF 995 R can be used for both continuous and pulse beam as two color scintillation monitor.

Introduction

Scintillators are often used for beam monitors. Desmarquest AF 995 R (High density sintered aluminum oxide including chromium oxide) is very high resistant materials for ion and electron beam from accelerators. Desmarquest AF 995 R is used as beam monitors for electron and ion accelerators. Desmarquest AF 995 R shows red color during irradiation and the red color are usually monitored by TV cameras. Very high sensitive and space resolving beam monitors are useful for steady state irradiation and very high time resolution monitors are useful for pulse irradiation. Especially it is very convenient to accelerator operation and application that one monitor can be used for both steady state and pulse irradiation. Two color scintillation monitors have such possibility. Very recently we have shown the possibility of two color scintillation monitor composed of Desmarquest for both continuous and pulse beams on the basis of emission spectrum data[1]. The present paper mainly describes the time profiles of emission of Desmarquest AF 995 R. Low energy side band emission of the visible band is also reported in the addition to the previously reported high energy side band emission.

Experimental

Desmarquest AF 995 R is 99.5% Al₂O₃ containing chromium oxide.

Desmarquest in a vacuum chamber was irradiated with 1 MeV H⁺ ions from a single-ended Van de Graaff accelerator of Research Center for Nuclear Science and Technology, University of Tokyo [2]. Emission spectra from Desmarquest were measured by a time resolving optical analyzer (OMA) with the wavelength region between 250 - 750 nm [3].

Desmarquest was also irradiated with electron beam from linear accelerator of Nuclear Engineering Research Laboratory, University of Tokyo[4]. Time resolved emission spectra were measured by both streak camera and photomultiplier[5]. Very recently the systems were modified and time resolution is 10 ps for the streak camera system and 400 ps for photomultiplier[6].

Results and Discussion

Fig.1 shows emission spectra of the visible band observed by optical multichannel analyzer (OMA) for Desmarquest AF 995 R irradiated with 1.0 MeV H⁺ at room temperature in vacuum chamber. Desmarquest has two emission bands: broad ultraviolet emission band with short lifetime and sharp visible emission band with long

lifetime[1]. The previous report showed only the shoulder part at the shorter wavelength side of the red emission band, because the cut-off wavelength of the detector system was about 700 nm. Fig. 1 shows shoulder parts at both shorter and longer wavelength sides, because the cut-off wavelength of the present detection system is about 800 nm.

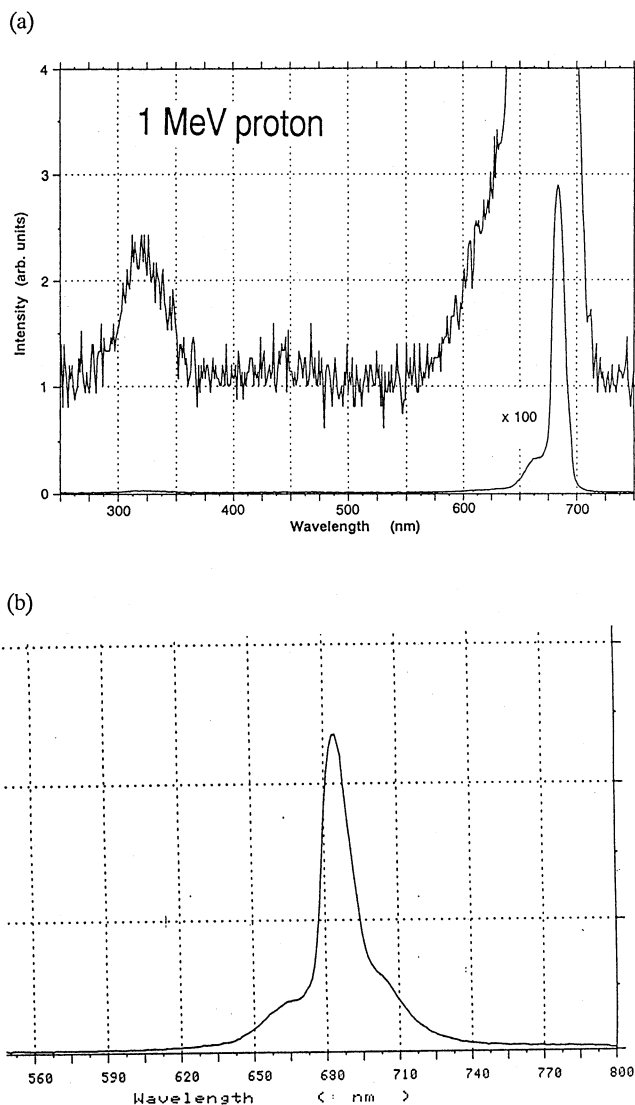


Fig.1 Emission spectra observed by optical multichannel analyzer (OMA) for Desmarquest AF 995 R irradiated with 1.0 MeV H⁺ at room temperature in vacuum chamber. H⁺ from a single-ended Van de Graaff accelerator. (a) previous data[1] (b) the emission spectra measured by the present system

The ultraviolet emission band was observed by electron pulse radiolysis system[1]. Fig.2 shows the time-profile of the ultraviolet emission measured by streak camera. The time profile of the ultraviolet emission band agree with the time profile of 10 ps electron pulse.

Conclusion

Desmarquest AF 995 R, which is the very sensitive and radiation resistant scintillation monitor, has very sharp visible emission band with long lifetime and broad ultraviolet emission band with short lifetime. The ultraviolet emission band decayed apparently within 10 ps electron pulse and useful for pulse monitoring. The visible emission band has red emission and long lifetime. The visible emission band are very useful for TV camera and eye. Desmarquest is one of candidates for both continuous and pulse beam as two color scintillation monitor.

References

1. H.Shibata, T.Ueda, T.Kobayashi, Y.Yoshida and S.Tagawa, Proc. 16th Linear Accelerator Meeting in Japan, 260 (1991)
2. N.Kouchi, S.Tagawa, H.Kobayashi and Y.Tabata, Radiat. Phys. Chem. 34, 759 (1989)
3. H.Shibata and S.Tagawa, J. Photopolymer Sci. Tech. 4, 169 (1991)
4. Y.Tabata, J.Tanaka, S.Tagawa, Y.Katsumura, T.Ueda and K.Hasegawa, J. Fac. Eng. Univ. Tokyo, XXXIV, No.4, 619 (1978)
5. H.Kobayashi, T.Ueda, T.Kobayashi, M.Washio and Y.Tabata, Radiat. Phys. Chem. 21, 13 (1983)
6. Y.Yoshida, T.Ueda, T.Kobayashi and S.Tagawa, unpublished data

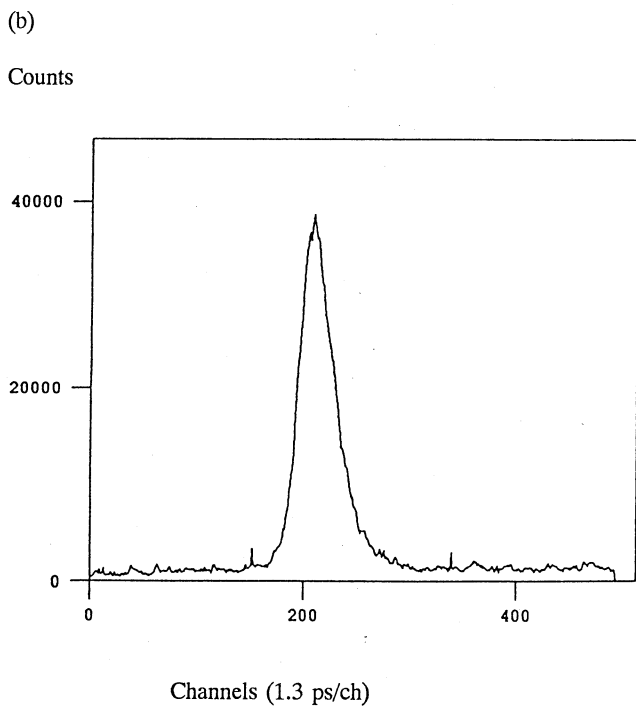
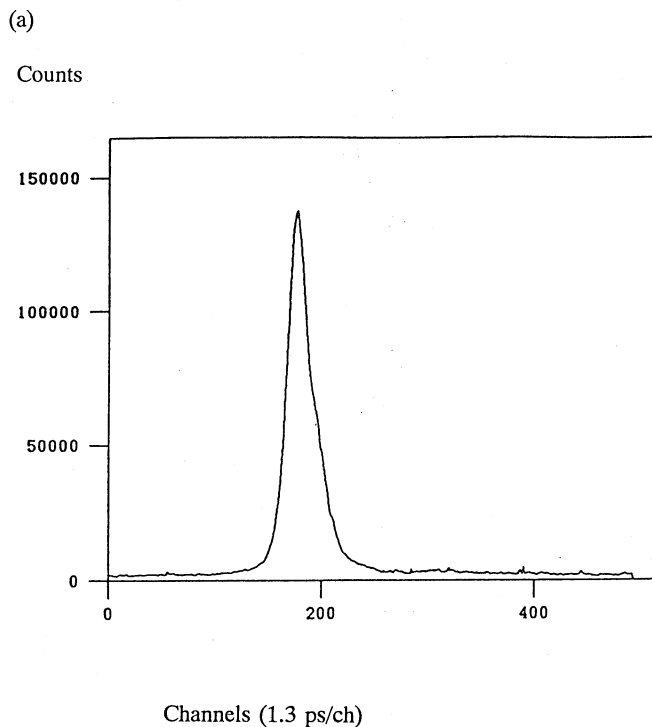


Fig.2 Time profiles of emission monitored during 10 ps electron pulse irradiation of Desmarquest AF 995 R (a) and quartz at room temperature.