Lumineschence spectra of inorganic scintillating screens induced by fast and slow extracted beams from SIS18*

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The scintillation process of inorganic material is a subject of high interest for material science. To answer questions of material damage processes the analysis of emission spectra is a common tool to compare possible influence of different ionizing particles.

Results on the spectral emission of inorganic scintillators induced by high energy impact of heavy ions were obtained. The emission spectra show no significant variation within the investigated ranges of ion species and beam intensities.

Setup

At the high-energy experimental test bench HTP investigations on the luminescence spectra of inorganic scintillators were performed in the frame of machine experiments preparing for FAIR project. Altogether seven inorganic scintillating screens (P43, P46, YAG:Ce, Chromium-doped and pure Aluminium Oxide) were mounted behind a beam exit window in air and irradiated with different projectiles from proton to Uranium. All projectiles, i.e. protons, nitrogen, nickel, xenon and uranium ions, were extracted from SIS18 with a beam energy of 300 MeV/u and intensities between 10^6 and 10^{10} particles per pulse (ppp). The measurements were performed in slow (300-400 ms) and fast extraction (1 µs) mode to analyze supposed saturation effects.

Beam-induced scintillation of the target material was explored using an optical spectrometer setup (Horiba CP140-202 and appropriate lens) and recorded by a monochrome CCD camera (15.2 mm diagonal chip size). Simultaneously, the complete scintillation light output was measured with a different camera system, see [1].

Experimental Results

The analysis shows no significant variation in the structure of the emission spectra. Examples of YAG:Ce and P43 phosphor emission spectra are presented in Figure 1.

Despite the fact that the emission intensity increases with increasing number of irradiating particles per pulse, no change in the emission spectra could be observed over the complete irradiation period. Moreover, the light emission of the investigated target seems to be independent of ion species. Within the total irradiation of up to $5{\cdot}10^{13}$ accumulated particles of all investigated projectiles, the formation of defects within the material does not seem to be dominant in this high energy region (see also [2]). These findings are comparable to studies on the light emission induced by other projectiles, like X-ray [3] or photons [4].

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References

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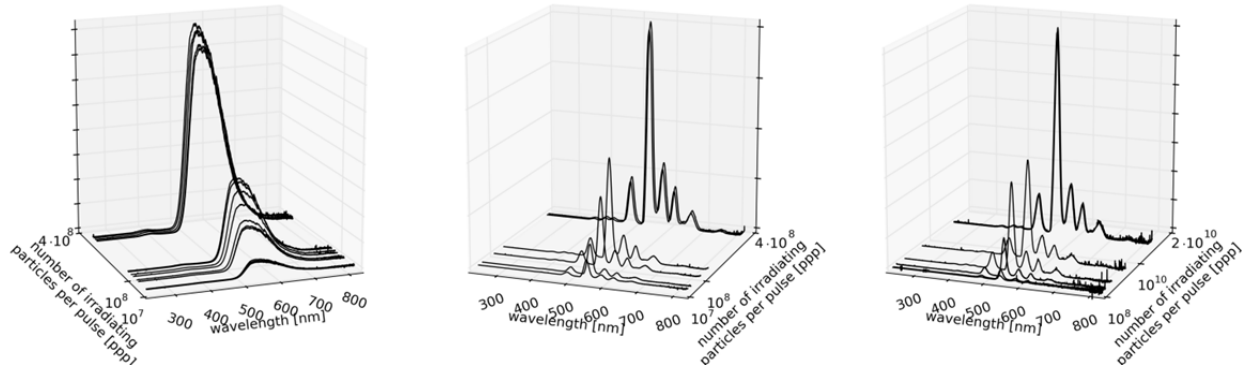

Figure 1: Emission spectra of single crystal YAG:Ce (left) and P43 phosphor (right) screens during irradiation with slow extracted Uranium beam (271 MeV/u, 300 ms extraction) at 10^7 up to $4{\cdot}10^8$ ppp. For comparison P43 spectra during slowly extracted Nitrogen beam (297 MeV/u, 400 ms extraction, 10^7 till $2{\cdot}10^{10}$ ppp) is shown on right side.

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