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The products and emission of the enshytraeus japonensis by irradiation of free electron laser

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Abstract: We report the experimental result of what kind of action the Enchytraeus Japonensis (EJ) takes by irradiation of free electron laser (FEL). FEL (Power; 300μJ, Wavelength: 2.9μm, Micro pulse width: 200 fsec,) of the wavelength which resonates with hydroxyl stretching vibration was observed with one shot reliance and change coupled device (CCD) camera. As a result, Reactivity from EJ were produced by FEL irradiation. The reactive products were increased in a few milliseconds. More shot of FEL irradiations, The EJ body was destroyed and we observed emission of laser ablation from the EJ body.

1.Introduction

Earthworms are well known in whole globe which features are that there is bottom of the food chain, and they work as the soil improvement agent. Also, earthworms ingest the organic substances, microorganisms and heavy metals in the soil which depend on environment for living. Our aims are discovered the new soil assessment technique using earthworms. In order to obtain the soil information from earthworms, we focused on the laser ablation luminescence. This luminescence is observed by laser irradiation, and laser ablation spectra can obtain the component materials from laser irradiated things. We consider earthworms are emission by laser irradiation which emission can indicate the ingested things in the earthworms. Laser ablation source is used free electron laser (FEL) because pulse width of this laser is very short (about 200 fs). This means thermally damage is less affect. The earthworms are used Enchytraeus Japonensis (EJ). In this study we report the behavior of EJ by FEL irradiation.

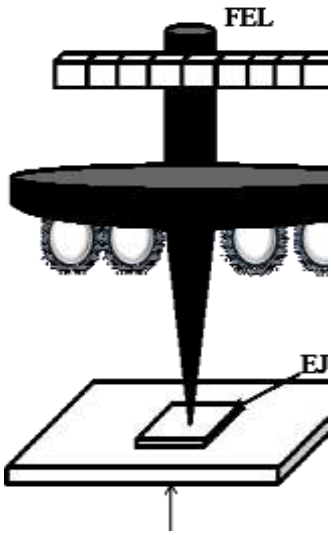

Figure 1 The FEL irradiation system for EJ

2.Experimental method

Figure 1 shows the FEL irradiation system for EJ. A living EJ is put on the quartz substrate as a sample. This sample set up on the X-Y stage. The focused FEL (Power: 300 μJ, Wavelength: 2.9μm) was irradiated to the EJ sample. Number of FEL shot was 6 shots. Interval of timebetween FEL shots was 5 second. Behaviours of laser irradiating EJ were observed by change coupled device (CCD) camera.

3.Experimental result

Figures 2 show the CCD camera image of EJ (length: 1.5mm diamater diamater: 0.3mm) which irradiated the one shot of FEL. Pre-FEL means this sample was not irradiated the FEL. 0 s sample means moment of FEL irradiation. The other samples mean after FEL irradiation. 0 s sample observed a laser spot at center of the EJ body. FEL irradiated EJ body were dvided two regions. One was the reactive product region around the laser spot area (#1). The other was the stability region (#2). #1 region grow larger over time. Also #2 region get lower over time.

In order to clearly the variation of #1 region, we calculated the areas of #1 region and all of EJ. $S_{\#1}$ means area of #1 region. S_{all} means all of EJ area. And $S_{\#1}$ was divided by S_{all} [$(S_{\#1}) / (S_{all})$].

Figure 3 shows relationship between amounts of $(S_{\#1}) / (S_{all})$ and elapsed time of one shot of FEL. In case of from 0 s to 0.4 s, $(S_{\#1}) / (S_{all})$ amounts was increasing. After 0.4 s, $(S_{\#1}) / (S_{all})$ amounts were saturated (about 0.32). These results indicated reactive products in EJ were not generated in a moment by laser irradiation, were slowly grown in a few milliseconds.

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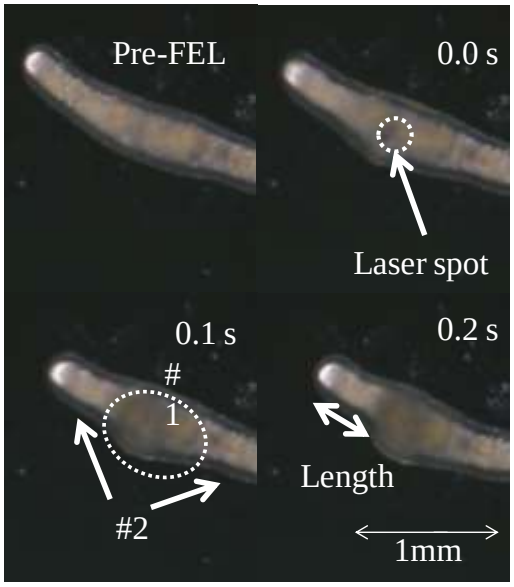


Figures 2: CCD camera image of the LEBRA-FEL irradiated EJ.

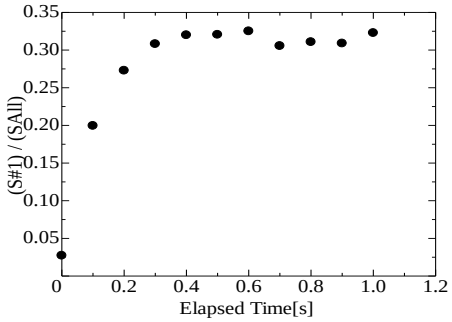
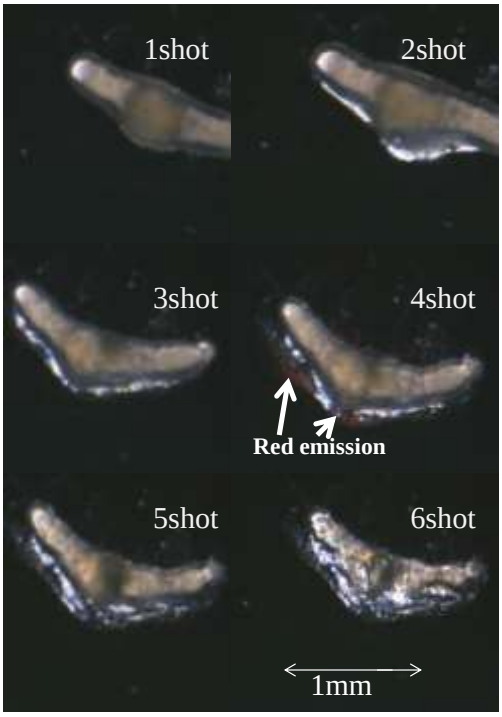


Figure 3: Relationship between amounts of ($S_{\#1}$) / ($S_{a\,ll}$) and elapsed time of one shot of FEL.

Figures 4 show the EJ behaviours of FEL shots by CCD camera. As noted previously, The 1 shot FEL irradiation sample had reactive production region. The 2 shot FEL irradiations sample observed white liquid at the edge of the EJ, and there was the reactive production region in this sample too. The 3, 4, 5 shot FEL irradiations samples were similar to 2 shot sample. However, the pigment colors of EJ body in 2, 3, 4 and 5 shots samples were whitely than that of the 1 shot sample. The 6 shots sample showed its all of body became white liquid status. This means number of laser irradiations could be broken the EJ body. Separately, red emission from the EJ was observed in 4 shot irradiations sample. We considered that this emission had possibility to study the qualitative analysis in the EJ. It is our future subject to measure this spectrum.



Figures 4: EJ behaviors by LEBRA-FEL irradiations.

Using these experiments the data of the reactive product of amplification were gathered, we demonstrated bioluminescence of the EJ.

4. Ackowledgement

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