Neutron Emission from Crushing Process of High Piezoelectric Matter in Deuterium Gas

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ABSTRACT

We studied neutron emission from a crushing process of a Lithium-Niobate($LiNbO_3$) single crystal in deuterium gas atmosphere. We observed excess neutrons 3 counts / h with a confidence level of 99.95% that correspond 120 neutrons / h emission from process.

1. Introduction

In a solid crushing process, chemical bonds broken and ionic charges appear on the crushing surface. An activate state is induced by these charges. The mechanochemical reaction arise extraordinary chemical reactions. The charge may generate high electric field. deuterons are accelerated by the field and collide with target deuterides. Consequently, nuclear fusion occurs and neutrons emits. Kluev et al. and Derjaguin et al. have reported neutron emissions from deuterated metal due to the mechanochemical process[1,2].

We report a neutron emission from a crushing process of a high piezoelectric materials in deuterium gas using vibromill.

2. Experimental

We chose a single crystal of lithium niobate as the piezoelectric material. It has a high piezoelectric strain constant of 6.92×10^{-11} C/N(d_{15}) and a relatively low dielectric constant of 85.2($X_{11}{}^{T}$). The generated voltage proportional to the piezoelectric strain constant and inverse proportional to the dielectric constant. The low conductivity ensures the charge retain after the charge unbalance of the fracturing process.

The mill was composed of a 500ml cup and a stainless steel ball (50 mm diameter) which vibrated at the frequency of 50 Hz with the vertical amplitude of 3 mm.

The neutrons were detected 10 ^{3}He proportional counters arrayed circularly in a cylindrical shaped paraffin block of 50 cm outer diameter and 10 cm inner diameter. The neutrons thermalized by the paraffin and reacted with ^{3}He making a proton and a tritium with a Q value of 760 keV. The pulse heights of output signals of the ^{3}He counters were digitized by analog to digital converters. The vibromill was set in the center of the cylindrical paraffin.

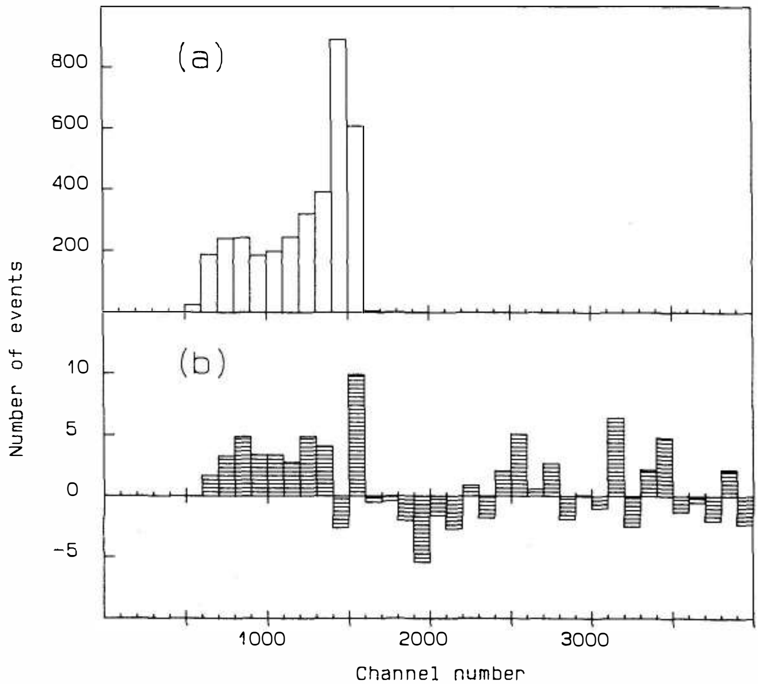

Figure 1. (a) shows ^{252}Cf emitted neutron distribution of counts over the channels of pulse height analyzer. The peak of 1500 channel in pulse height distribution corresponded the energy of 760 keV thermal neutron.

(b) shows pulse height distribution of excess emitted neutrons summation over lithium niobate + deuterium gas 12 samples. A neutron spectra was observed at 500-1600 channels. Reference was used 12 h averaging value back ground from 132 h.

3. Results and discussion

The pulse height distribution is shown in the figure 1 (a). In order to increase the signal to noise ratio, counts between 600 and 1599 channels were selected. The detection efficiency was measured to be 2.6% by a calibrated ^{252}Cf source.

The experiment was done in the low background facility at Nokogiri mountain. of The Cosmic-ray Research Institute, The University of Tokyo. It was located underground at the depth of 100 m water equivalent. The count rate of the background was observed 7.6 counts / h. The crushing for a sample was continued 1 hour duration. The crystal of lithium niobate was ca. 3 mm granule initially and after 15 min crushing the size was reduced to ca. 1 µm diameter. The figure 1 (b) shows the excess neutrons pulse height distribution of the summation of 12 samples of lithium niobate + D_2 system. It was compared with normalized 12 h background taken during 132 h. The sum of bbetween 1600 to 4000 channel counted neutron were scarcely slight 1.5. However 600 to 1599 channel counted neutrons were obviously excess 35.8. Table 1 shows the experimental results 16 samples on crushing process. Derjaguin et al.[2] observed excess neutron emission on $Ti+D_2O$

Table 1

sample & amount	neutrons (counts/hour)
Ti 10g + D_2O 8 ml	4
Pd 5g + D_2O 8 ml	5
$LiNbO_3$ 12g + D_2 101 kPa	11
$LiNbO_3$ 13g + D_2 101 kPa	12
$LiNbO_3$ 15g + D_2 1.1 kPa	18
$LiNbO_3$ 15g + D_2 6.6 kPa	12
$LiNbO_3$ 20g + D_2 16.6 kPa	11
$LiNbO_3$ 16g + D_2 13.2 kPa	5
$LiNbO_3$ 10g + D_2 24.7 kPa	8
$LiNbO_3$ 10g + D_2 25.7 kPa	9
$LiNbO_3$ 15g + D_2 101 kPa	9
$LiNbO_3$ 12g + D_2 101 kPa + LiD 2g	10
$LiNbO_3$ 12g + D_2 101 kPa + LiD 2g	13
$LiNbO_3$ 13g + D_2 101 kPa + LiD 2g	8
$LiNbO_3$ 12g + air 101 kPa	8
$LiNbO_3$ 10g + N_2 101 kPa	9

system. However we did not observe excess neutron in $Ti+D_2O$ or $Pd+D_2O$ systems. On the lithium niobate + deuterium gas system, we observed excess neutron emission over the background.
Neverthless, in air and N_2 +lithium niobate system, we did not observe excess neutrons. For intensify of the density of deuterium atoms, we add a lithium deuteride in the system. Also, on the lithium niobate + lithium deuteride + deuterium gas system, we observed excess neutrons. All the counts of the 12 runs of lithium niobate + deuterium gas system were 127 compared to the expected background of 91.2. If our observed background fluctuation was Gaussian distribution, we can calculate mean and standard deviation 91.2 and 9.5 respectively. The value 127 corresponds 0.05% probability if it was fluctuation of the background. So, we observed 35.8 excess neutrons in crushing process. These neutrons were emitted by an acceleration of deuterium at high voltage field in crushing process of high piezoelectric material.

4. conclusion

We conclude that the excess neutron (average 3 neutrons / hour) observed by mechanochemical crushing process of lithium niobate in deuterium gas with confidence level 99.95%. The D-D fusion reaction was occurred in the crushing process of lithium niobate crystals. We named this fusion reaction "Mechano neuclear reaction".

5.References

1. V. A. Kluev et al. 1984, Dokl. Phys. Chem. 279, 1027.
2. B. V. Derjaguin et al. 1989, Nature 341, 492.