HIGH-SENSITIVITY MEASUREMENTS OF NEUTRON EMISSION FROM Ti METAL IN PRESSURIZED D_2 GAS

H. O. Menlove
Group N-1, MS E540
Los Alamos National Laboratory
Los Alamos, NM 87545

ABSTRACT

Recent measurements of neutron emission from Ti metal in pressurized D_2 gas have established the multiplicity distribution of neutron bursts emitted from the samples. A new ^3He detector system with high sensitivity has been used to lower the detection limit so that small bursts emitting from 2-10 n can be distinguished from the cosmic-ray background. The frequency distribution of the neutrons indicates that the lower multiplicities occur much more frequently than the higher multiplicities as shown in Fig. 1. The improved sensitivity in our new detector system was obtained by using low radioactive background stainless-steel tubes, a small detector volume with high efficiency, and additional cosmic-ray shielding. The detector consists of two independent segments making up inner and outer rings of ^3He tubes. The inner detector has nine ^3He tubes (2.5 x 30 cm), and the outer detector has forty-two ^3He tubes (2.5 x 50 cm). The combined total efficiency is 44%. The low-background inner detector has a singles count background of 97 counts/h and a coincidence count background of only 0.67 counts/h. The corresponding singles efficiency (2.3-MeV neutrons) is 19% and the coincidence efficiency is 3.6%.

This system has been used to detect low multiplicity neutron emissions from samples where the yield is 5-10 times larger than the background level for intervals of many hours. This improved sensitivity makes it possible to monitor the neutron yield characteristics of samples at a much lower level than was previously possible. We have shown that the most frequent events emit neutrons with 1-10 n and the larger burst events 20-200 n occur much less frequently. Figure 2 shows an example of the multiplicity distribution we measured for a sample containing Ti metal chips in D_2 gas pressurized to 800 psi. The active period lasted for several days following three weeks and six liquid-nitrogen temperature cycles that were inactive. On the right side of Fig. 2 is the multiplicity distribution for a control sample of Ti metal chips in H_2 gas that was measured for the same amount of time both before and after the active sample runs.

These multiple small burst events (2-10 source neutrons) give us the ability to study the details of the

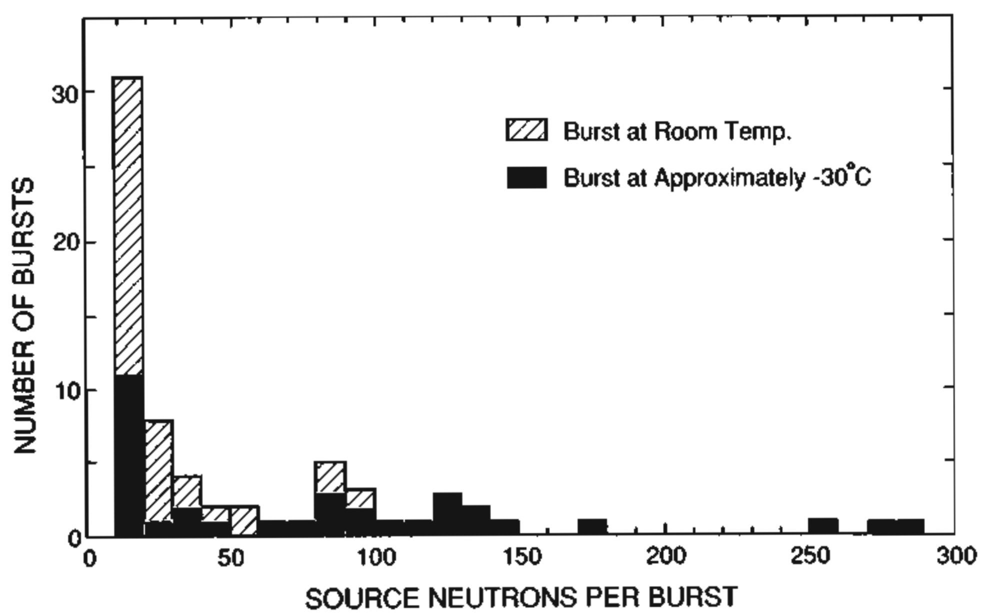

Fig. 1. Neutron burst multiplicity frequency distribution for 13 active samples of Ti metal in pressurized D_2 gas.

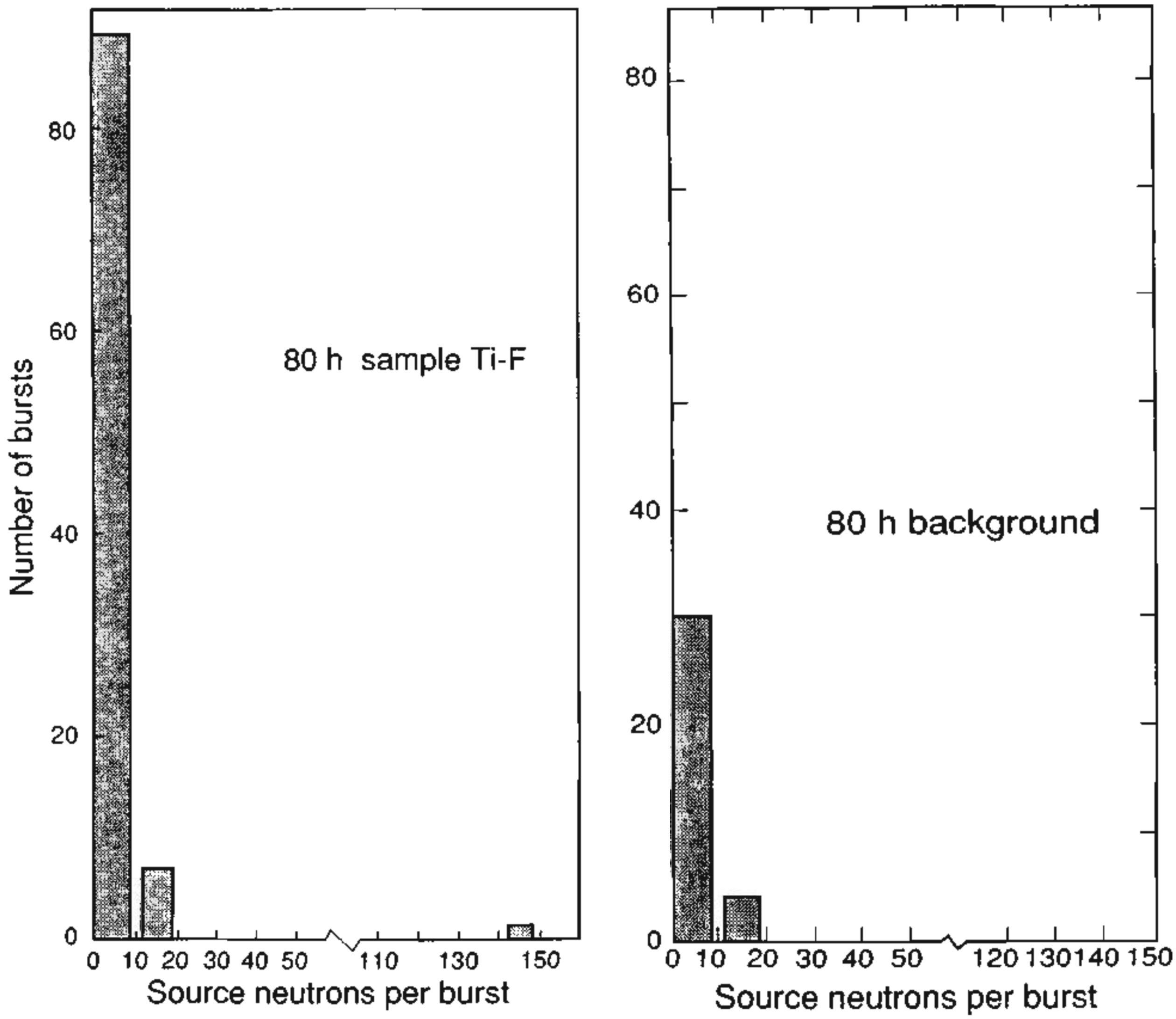

Fig. 2. Neutron source multiplicity frequency distribution for a single Ti sample showing the high frequency for the low number of source neutrons per burst.

phenomena that were not observable before. The results are now reproducible in that we can remove an active sample from one detector system and still measure the excess yield for the same sample in the adjacent detector system. The neutron emission rate is very low (0.001 n/s), and we can detect it only by means of our time-correlation counting and underground laboratory.

Only an abstract is given for this paper because the full paper has been submitted for journal publication.