New Nuclear Reactions: Alpha emission from pressed steel

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Changes of nuclear composition and possible detection of emitted nuclear particles after ultrasound irradiation were reported both in liquid [1-3] and solid[4, 5] material. In order to study these phenomena at lower rate, a mechanical press was used[6,7] to create strain/stress cycles in steel bars. In fact, while the period of ultrasound was of the order of 10^{-7} seconds, periods of the order of 10^2 – 10^3 seconds were used in the case of mechanical press.

Two AISI304 steel bars of cylindrical shape with 2 cm diameter, 20 cm height and about 0.5 kg weight were submitted to cyclic compression stress (ref. 6,7 and fig.1) by a Galdabini press (QUASAR 600) endowed with control and recording systems: they were first pre-compressed for one minute at 300 N and then subjected to five consecutive fatigue cycles. Each cycle consisted of a compression phase from 300 N to 130 kN and a fast stress release phase (about 10 s) from 130 kN to 300 N. A different strain rate was applied in each of the five loading stages: 1, 2, 3, 4 and 5 micron/s, respectively. Strain and stress were automatically recorded as functions of time.

The surrounding area was monitored by three ZnS(Ag) alpha detectors, a Geiger counter, and some polycarbonate CR39 alpha-detectors to check whether ionizing particles were emitted. Neutron emission were monitored by a ^{3}He proportional detector.

The same detectors and the same five stress/strain cycles were used with a reference sample made of Teflon, having the same shape and size of the steel bars.

The highest value of intensity (counts per second - cps) registered among the three ZnS detectors in the case of Teflon was assumed as background level common to all the three detectors. This value was subtracted to all the counts registered in the case of the steel bars.
Only the positive results were assumed as possible evidence of alpha emission and are reported in fig.1

The cut introduced by the above procedure is very severe as the highest background value is used for the three detectors, thus disregarding their different efficiency and assuming the most pessimistic case.

The same procedure of background subtraction was also adopted in the case of the Geiger counter and ^{3}He proportional detector of neutrons, although using one instrument for each instrument.

The positive results of the three ZnS, Geiger and neutron detectors are reported in figure 1. No positive result was obtained in the case of neutron detector.

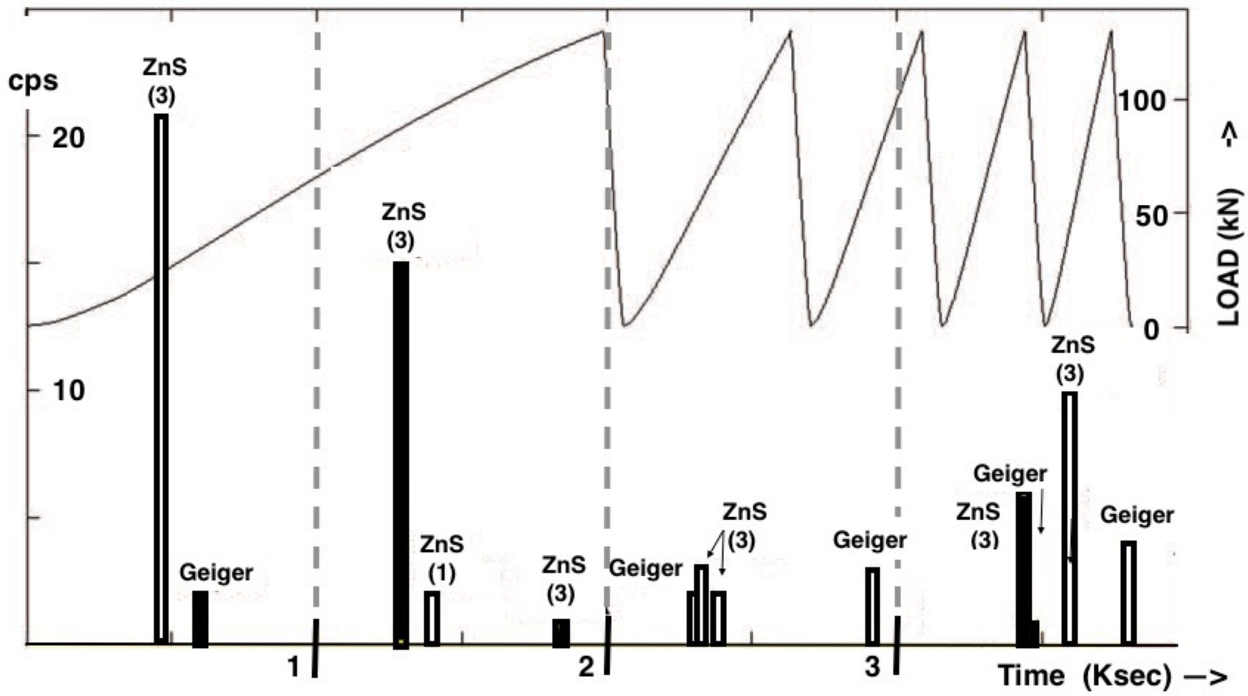

Figure 1. Stress as a function of time in the five loading cycles of AISI304 steel bars is reported in the top part (scale on the right). The strain rate was 1 micron/s in the first cycle, 2 micron/s in the second, 3 micron/s in the third, 4 micron/s in the fourth and 5 micron/s in the fifth. The fast stress release occurred in about 10 seconds.

The counts above the background level (cps - left scale) are reported in the bottom part. The corresponding detector is indicated (the three ZnS detectors are labelled as 1,2 and 3). The filled columns refer to one sample and the empty ones to the other.

The Cr39 plates were used to evaluate the direction of the emitted alpha particles: in fact, the positions of the alpha-tracks on the top surface of the plates were compared with the corresponding positions in the bottom surface.

The reference direction was along the geometrical axis of the cylindrical bars. In particular, as the bottom of the press was kept fixed while the upper part moved, the pressure front and the corresponding energy were assumed to flow from top to bottom and this was the chosen orientation of the reference direction.

The emission angle of the alpha particles with respect to this reference was in the range 34°-38°. This value is compatible with the forecast of Deformed Space-Time theory(8,9) and agrees with the results later obtained in neutron emissions(10).

When the directions of two tracks had a common point in the bulk of the sample, they were assumed to be produced in the two corresponding different regions on the surface, otherwise the energy to cross part of the sample should be extremely high. After this assumption, the sources of alpha tracks resulted close to the contact line between the sample and the detector, thus also excluding longer paths in the air between sample and detector.

The alpha particles were able to cross up to 0.1-0.2 mm in the air. Thus, their energy was evaluated to be at least 40 keV, which is also the lowest energy detected by Cr39.

Alpha emissions without neutron detection was in contrast with the past results, which were the starting points for this experiment. In fact, mainly neutrons were detected in the past and no evidence of alpha particles was reported.

To clear this point, measurements of ionizing and nonionizing particles were performed[12] during the routine job of tension rupture tests at the Meccano SpA enterprise in Fabriano (AN, Italy): 60 cylindrical steel rods, having 100 cm height and 8, 10 or 12 mm diameter, were stretched. A ZnS(Ag) alpha detector, a Geiger counter with related detector for alpha, beta and gamma radiation and ^{3}He proportional neutron counter were used.

For each sample, the highest value of counts per second has been taken into consideration at each detector: in the case of Geiger and ZnS alpha counter, the distribution of these values can be roughly divided into two regions: one, at low count per second, corresponding to the alpha particles previously detected from samples cyclically stressed without rupture; the other, at higher counts, was attributed to the electrons emitted during and after the fracture, as they are described by other authors[11].

Two population were also found in the distribution of maximum counts from the neutrons detector: the most of samples registered a very low intensity, which corresponds to the background level. Other samples reached an intensity some tenths of time higher, which was assumed as a hint for neutron emissions when the rupture conditions are attained.

When samples were stressed without rupture, the neutron detector registered sometimes a maximum of one neutron per second after working some hours. Thus, in that case the intensity was practically zero. In case of stress with rupture, on the contrary, counts of some tents per second are obtained by using the same detector.

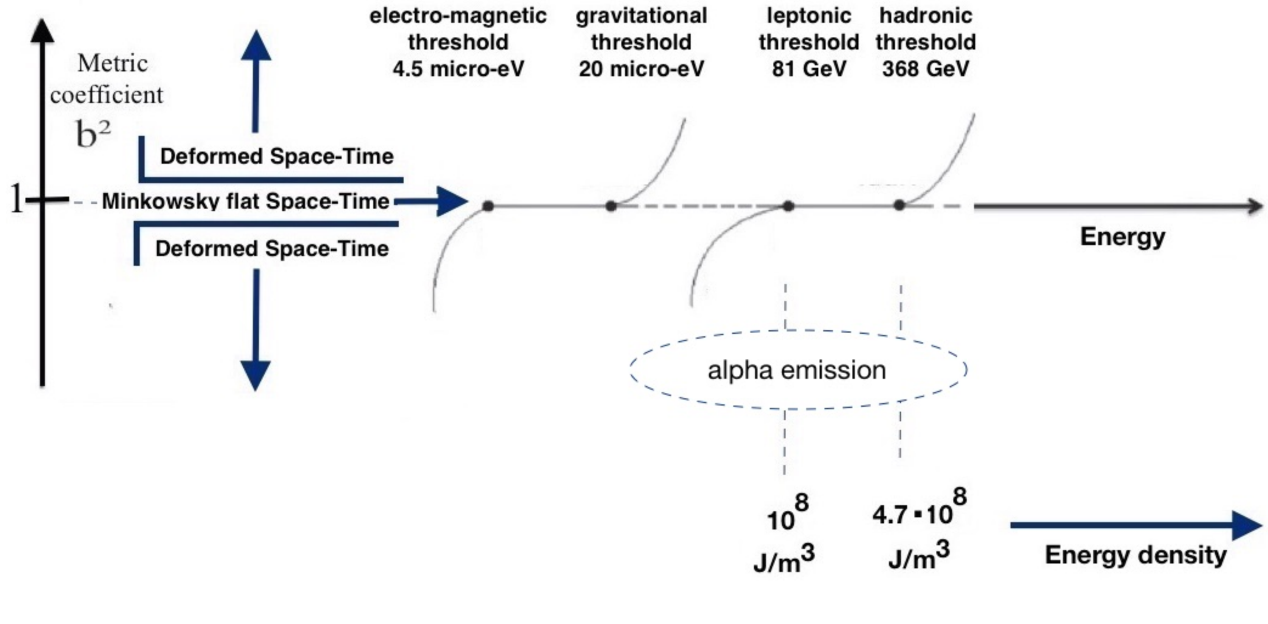

Figure 2. The energy density inside the samples at the alpha emissions was evaluated to be in the range 10^7 – 10^9 J/m^3 (ref.13). It could correspond to a deformed Space-Time either of leptonic (less than 10^8 J/m) or hadronic (above 4.7 10^8 J/m^3) interaction.

The different behaviour was interpreted as a consequence of different energy density in the two cases. In fact, thresholds of energy density in the materials were supposed[13] to correspond to the energy thresholds forecast in the Deformed Space-Time theory[8,9]: these thresholds separate the flat

Minkowsky Space-Time from Deformed Space-Time (figure 2). Reactions occurring in the deformed condition can result in particle emissions if observed from the flat Space-Time of the detectors.

The energy density inside the not-ruptured samples at the time of alpha emissions was evaluated[13] to be $10^7 – 10^9$ J/m^3. From figure 2, one can see that this range corresponds either to leptonic or hadronic interactions occurring in deformed Space-Time.

At higher energy density, the hadronic interaction is predominant and neutron emissions were also expected[13]. Higher energy density corresponds to ruptured samples and neutron emissions were detected in this case[12].

Further information on the emission of nuclear particles, the related changes of nuclear composition and the supporting theory can be found in Ref. 14, which is ever updated.

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