Response of a pentagonal PZT element as a component of a 4π real-time detector

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A shell-structured detector has been proposed to monitor tiny space debris/dust in real time. This form was aimed at detecting hypervelocity particles free from the incident direction. The simplest structure was accomplished in a dodecahedron that comprised twelve pentagonal elements, each of which was fabricated from piezoelectric lead-zirconane-titanate (PZT). The pentagonal element was 9 cm^2 area and 1mm thick. On the surface, one pentagonal electrode and five narrow electrodes were coated at the central region and at the edges, respectively.

The response of the pentagonal element was studied using hypervelocity iron particles in the velocity range from 4 to 7 km/s.

The results were in the following: 1. The response curve was similar to that by a small circular-type element [1,2]. The amplitude immediately after collision showed a linear relation with the momentum at collision. 2. The coordinate at collision was uniquely determined to measure the propagation time by arranging the narrow electrodes. 3. When the pentagonal electrode was divided into segments, the phase of output signal was interesting. It appeared opposite between the hit and the missed segments

A preamplifier to match elements of high capacitance was discussed.

In summary, the characteristics of the pentagonal PZT elements were studied for a 4π debris/dust detector. The output amplitude was proportional to the momentum of the impact particle in this velocity range.

[1] T.Miyachi et al., Adv. Space Res. **35**(2005)1263.

[2] T.Miyachi et al., J. Appl. Phys. **98**(2005)014110.