Search for Short-Lived Neutron-Rich Nuclei Produced by Charged-Particle- Induced Fission of 238U with IGISOL

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The observation of new neutron-rich isotopes in the $f_{7/2}$ region from Ni (Z=28) to Kr (Z=36) is of interest for nuclear spectroscopy as well as nuclear astrophysics. Especially, the doubly magic nuclei $^{78}_{28}Ni_{50}$ is important in understanding properties of nuclear shell and pairing effects far apart from the stability line and element synthesis involving the astrophysical r-process.

To search for these unknown neutron-rich nuclei, the new on-line isotope separation technique (IGISOL: Ion-Guide Isotope Separator On-Line) coupled with the proton-induced fission of uranium is one of the most powerful tools because of its properties, e.g., fastness and versatility of separation for every element.[1)]

The test of the applicability of proton-induced fission coupled with an IGISOL has been done by our IGISOL system using the CYRIC cyclotron. Two metallic foils of natural uranium of 40 mg/cm^2 thickness were placed at the positions of the center and 5 mm downstream from the center in the target chamber of the IGISOL. Parameters for operation of the IGISOL (pressure of ^{4}He gas and skimmer voltage etc.) are tuned around the optimum values obtained in reference 1. As the first step, the optimum proton beam energy was determined from the measurements of nuclear charge (element) dispersion of fission products for several masses[2)] in order to get higher yields in the border region between known and unknown isotopes. In the second step unknown isotopes were searched in the range of mass number 80 to 90. The detector system consisted of thin plastic β-detectors to reduce the back-ground by β-γ coincidence method and a high-purity Ge γ detector to identify the element placed just behind the tape of mass separator beam position. The two β detectors were in the vacuum and surrounded the sample position (beam position) on the tape to get higher efficiency. Since the half-lives of most of the unknown isotopes in this region are estimated to be shorter than 1 sec, growth- and decay-measurements were performed by repeting the following sequence; accumulation of mass-separated samples for 1 or 2 sec, stop of accumulation during 1 or 2 sec, and tape movement to refresh the sample position. The signals from each detector were stored in magnetic tapes by list-mode tagged with a clock. Figure 1 shows the isotopes identified by our IGISOL-fission experiment in the mass-number 80 to 90 region of the neutron-rich side. Typical yields in these experiments, for example, were about 150 atoms/μC, 800 atoms /μC and 6000 atoms/μC for ^{88}Se, ^{88}Br and ^{88}Kr, respectively. Although several gamma-rays having a half-life shorter than 1 sec were detected, they have not yet been assigned to the decay of the unknown ^{88}As because of low statistics. From the preliminary experiment mentioned above, it seems that the proton-induced fission together with an IGISOL is a powerful tool to for search for unknown nuclei in the neutron-rich side as well as in the neutron-deficient side.

References

1) Yoshii M., Hama H., Taguchi K. et al., Nucl. Instrum. & Methods Phys. Res. **B26**, 1-3 (1987) 410.
2) Kudo H. et al., in this report.

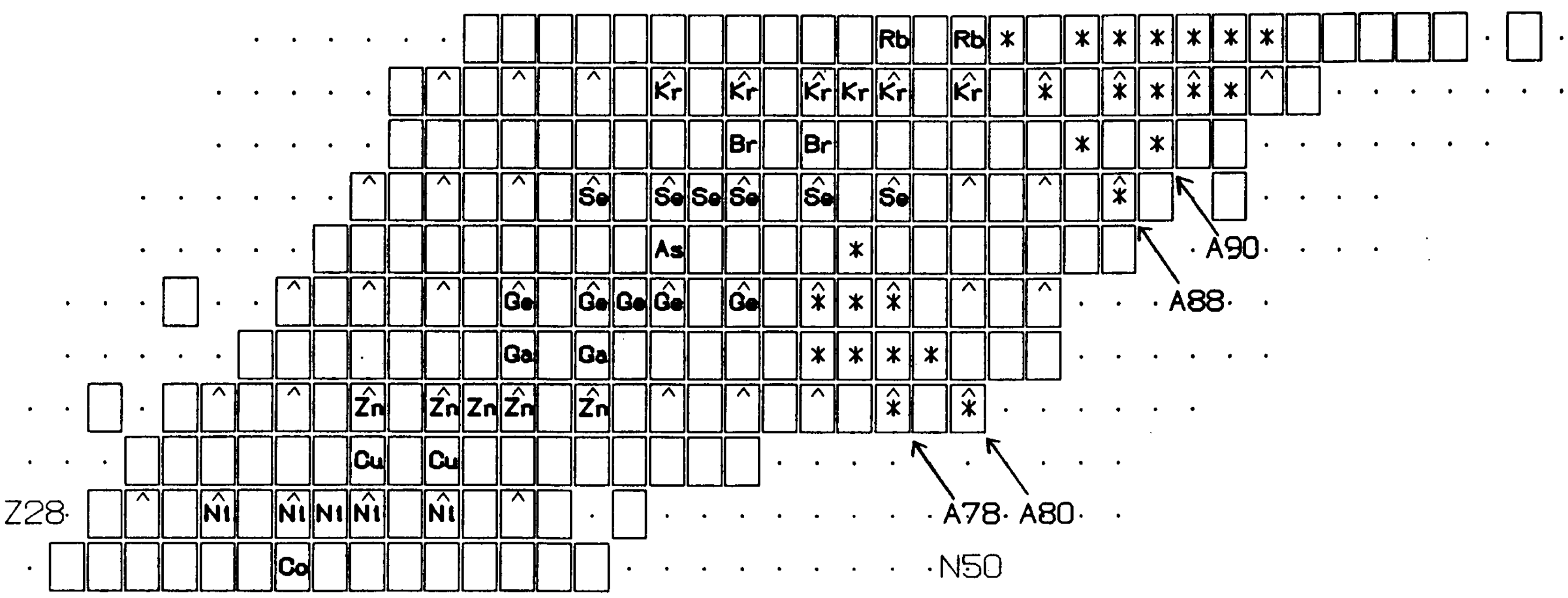

Fig. 1. Identified Isotopes by Tohoku-IGISOL.
∧: Even-even Nucleus, **Bold**: Stable Nucleus, □: Known Nucleus,
•: Unknown Nucleus, *: Present Data.