4. Development of high temperature targets and ion sources for on-line radioactive isotope production.

The ion source-target unit is the main part of an ISOL system. Therefore the development and manufacture of high efficiency ion sources and targets was one of the most important tasks at the IRIS facility. The ion-source target system should satisfied to many requirements, the major ones of which are the fast release time and the acceptable for experiments yields of radioactive nuclides. The different types of targets and ion sources were developed enabling to produce radioactive isotopes of the Periodic table of elements.

At the IRIS facility high temperature targets for effective production of a large set of short lived nuclides have been worked out and used for on-line experiments. The use of a tungsten foil as a target container material allows to maintain the working temperature for refractory foil and refractory metal carbide targets up to (2800–3000)°C and up to 2500°C for uranium carbide targets. Tests of Ta, Ta-W, TaC, NbC and UC target materials in a tungsten container in the temperature interval of (2400–3000)°C demonstrated a high reliability of used targets during long (of about 100 hours) on-line runs. A large set of the neutron deficient and the neutron rich nuclides were produced making use the developed target. From a high temperature refractory target with a tantalum foil as a target material the isotopes of practically all rare-earth elements were produced. That target was used for laser spectroscopic investigations of chains of Yb and Tm neutron-deficient isotopes. The Reseach and Development of high temperature refractory targets was the main goal of the ISTC project # 1112. Experiments according the project program were carried out at the IRIS facility in 1999-2002.

New combined high temperature ionizing target device for laser investigations of nuclei of the hard volatile elements was developed at the IRIS facility. In pioneering experiments on laser spectroscopy the resonance ionization method was applied inside the volume of target itself. The yields of short-lived Gd isotopes and the laser selectivity were increased by the factors of 2 and 7 correspondingly as compared to usual method of resonance ionization inside the ion source volume.

In collaboration with LNL, Italy and GANIL, France a number of off-line and on-line tests on the R&D of uranium carbide target of a high density (11g/cm3) have been carried out. A large variety of nuclides from Na to Fr have been produced making use the high density uranium carbide target coupled with a high temperature electron beam ion source. The research and development of high density UC targets was the main goal of the ISTC project # 2965. Experiments according the project program were carried out at the IRIS facility in 2006-2007. Presently the experiments have been continued on the delay time and production yield measurements of neutron rich isotopes of Rb and Cs from a very massive high temperature UC target (up to 0.7 kg).

*(For more detailed review see article "**Development of high temperature targets and ion sources for on-line radioactive isotope production**" in PNPI report of the High Energy Physics Division" **Main Scientific Activities 1997-2001**").*

Among the different types of targets developed at the IRIS it is worth noting the high temperature (up to 2300oC) targets on base of carbon-metal composite formed by pyrolises of diphtalocyanine of corresponding metal . As a metal there were used elements in a wide range of the Periodic Table, such as Ti, Zr, Nb, Mo, some REE, Th, U, Cm and others. Due to high porosity these targets revealed excellent release properties, what allowed to obtain and investigate a set of new nuclides near the edge of as proton as well as neutron stability. The peculiarity of this material consists in forming of micro-cavities in carbon matrix during the pyrolises process. Heterogeneous atoms, which happen to be put inside these cavities, can not be escaped out. For example, the full evaporation of Xe out of this matrix is going only by 2100oC. This experimental fact was the main base for ISTC proposal (№2391) on preparation of carbon matrixes for the long-living isotope transmutation.

*(For more detailed review see article "**The IRIS facility and nuclear-spectroscopic investigations of nuclides far from the beta-stability region**" in PNPI report of the High Energy Physics Division " **Main Scientific Activities 1971-1996**" and NIM, B70 (1992) ,69).*