

## SIMULATED EXPERIMENTS OF SCR BOMBARDMENT OF TITANIUM IN PLANETARY SURFACES WITH 40 TO 67.5 MeV PROTONS

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Solar cosmic rays (SCR) are energetic nuclei emitted by the sun. They are mainly protons (89%) and alpha particles (10%) and cover energies up to 200 MeV/nucleon and more [1,2]. This Solar Cosmic Radiation bombards the earth and other bodies in the solar system and causes nuclear reactions which may result in stable and radioactive products. These interaction products can be used to study e.g. the exposure history of planetary surfaces or the historical record of solar cosmic radiation itself. Recently Reedy et al [3] proposed the needs for the study of solar cosmic ray fluxes and suggested to measure cross-sections of long lived radioisotopes induced by particle radiation in the range of solar cosmic rays. These are needed to interpret measurements of SCR induced nuclear reactions in meteorites, and planetary surfaces [4].

Recent advances in Accelerator Mass Spectrometry made  $^{41}\text{Ca}$  ( $T_{1/2}=1.0 \times 10^5 \text{ y}$ , no gamma-rays) available for applications in cosmochemistry (Sharma, P. et al) [5]. In order to interpret  $^{41}\text{Ca}$  data obtained from extraterrestrial samples cross sections and production rates of this isotope from its major target elements need to be known. In lunar surface material the element Ti is one of the important target-elements for  $^{41}\text{Ca}$ . In a previous study Fink, D. et al. [6] began to study the production rates of  $^{41}\text{Ca}$  from Ti using protons in the range of 35 to 150 MeV. In order to obtain proton induced  $^{41}\text{Ca}$  cross sections from Ti with better energy resolution from threshold to 70 MeV we have performed proton experiments at the Crocker Nuclear Laboratory at UCD.

Excitation functions for some short-lived radioisotopes and  $^{41}\text{Ca}$  were to be measured by means of the thin target stacked foil technique [7]. High purity foils of natural titanium of 25mm and 12.5mm thickness (Goodfellow Metals Ltd., U.K) were used as targets and beam degraders. Two stacks of foils were irradiated. The first stack degraded the proton energies from 67.5 MeV (maximum) to 47 MeV and the second stack from 50 MeV to 18 MeV. Four high purity Au-foils per stack (Goodfellow Metals Ltd., U.K) were used to monitor the beam energies and fluxes in addition to the titanium foils themselves. A single gold foil was irradiated immediately prior to stack irradiations under exactly the same conditions for later comparisons [8]. The irradiations were done at the 70 Inch Isochronous Cyclotron of the University of California, Davis. The irradiation times were 2 and 3 hours respectively at 300 nA. Irradiation procedures were described by Michel et al [9] and were used with only minor modifications. Energy degradation was calculated with an in-house computer program and following irradiation short-lived radioisotopes were analyzed by standard gamma-ray spectrometry. The gamma-ray spectra were analyzed using a PC-based nuclear data deconvolution program. The detector efficiency was determined using a calibrated NIST mixed radionuclide source.

We have determined cross-sections for a number of short-lived ( $^{48}\text{V}$ ,  $^{46-48}\text{Sc}$ ,  $^{47}\text{Ca}$ ,  $^{42+43}\text{K}$ ) radioisotopes which will be presented and discussed.  $^{41}\text{Ca}$  is in the process of being prepared for AMS measurement. We will present and discuss the results from these measurements.

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