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RECOMMENDATION FOR THE PREPARATION OF MODULAR SIZE METALLIC ISOTOPE SAMPLES FOR NEUTRON CROSS SECTION MEASUREMENTS

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There are many neutron cross section experiments which require the use of pure metallic samples of separated isotopes. For example, neutron scattering experiments are hampered by the presence of chemical contaminants such as oxides and carbides, absolute total cross section measurements are disturbed by adsorbed gas and/or water (particularly on finely divided powder samples), moderate-thickness capture measurements suffer from the complication of multiple scattering from contaminants, etc.

Since the conversion to metal represents a considerable expense and the subsequent reforming to specific geometric shapes represents additional expense and loss of material, we recommend that metallic samples for neutron cross section experiments be produced in a single modular size which can serve many different experiments. Further, we recommend a square sample configuration 1.25 cm on a side and 0.08 cm thick as suitable for most general use.

For neutron capture and resonance scattering measurements the modular squares can be arranged in a large area array in thickness increments of 0.08 cm. For MeV energy transmission measurements samples can be formed by stacking the 1.25 cm x 1.25 cm squares to the desired thickness. For even thicker arrays, the individual squares may be tilted relative to the neutron beam, so that a rectangular sample of 1.25 cm x ($<$1.25 cm) is presented to the neutron beam. For keV and resonance energy measurements these squares may be stacked to produce intermediate area arrays. For example, a sample of 2.5 cm x 2.5 cm x 0.24 cm

can be prepared from twelve modular squares arranged into three layers of basic samples. The effects of troublesome gaps which may occur between adjacent edges can be minimized by slightly displacing the three layers relative to each other so that no "holes" will occur in the final sample. A sample suitable for neutron scattering measurements may be prepared by stacking squares of samples to the desired height. To reduce the corner effect of the squares, the layers can be rotated slightly as the sample is stacked, thus producing a "diffuse sample edge". The effect of this diffuse edge can readily be handled in multiple scattering corrections and the sample retains the desirable cylindrical symmetry.

The modular samples can readily be prepared (from malleable metal) by rolling out a 0.08 cm thick metallic sheet and then shearing the sheet into 1.25 cm x 1.25 cm pieces with only minimal isotope losses resulting from the shearing process. Consideration should first be given to the production of metallic samples which are relatively stable in air and can be handled without special equipment. Specifically, modular metallic separated isotopes of high chemical purity of the following elements would be useful: Mg, Ti, Cr, Fe, Ni, Cu, Zn, Zr, Mo, Ru, Pd, Ag, Cd, In, Sn, Sm, Er, Yb, Hf, W, Ir, Pt, and Pb.

We recognize that the modular thickness of 0.08 cm may be too thick for certain experiments, and that thinner or other special sample sizes may be requisite from time to time. However, if the 1.25 cm x 1.25 cm dimension can be preserved a thinner sample would still serve the same purpose as long as the individual squares are not so warped as to prevent suitable stacking.

RECOMMENDATION

We therefore suggest that the USAEC recommend a square modular sample of size 1.25 cm x 1.25 cm x 0.08 cm and that the USAEC generally authorize the fabrication of metallic research samples from the isotopic loan pool in conformance with this modular size.

Where requisite to particular experiments, samples may be fabricated to other dimensions, but special justification should be required for the fabrication of non-modular size metallic samples or for the modification of already fabricated samples. If a modular sample is destroyed by special fabrication procedures, the user may be liable to returning it to the original modular form. Judgement and review of special fabrication requests as is necessary should be the responsibility of the Division of Research USAEC and such advisory personnel as it may delegate.